

POWER TRANSMISSION DESIGN

OCTOBER 1961

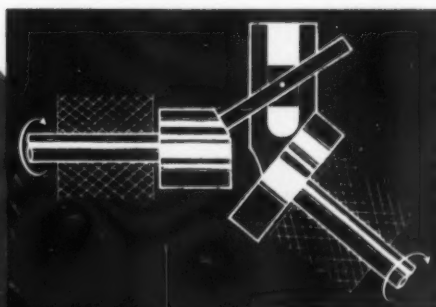
INCLUDING BEARING DESIGN/APPLICATION

Think only
rolling element
bearings are
anti-friction?

TFE
tape-lined
bearings

see contents
page 5

Know
What
This Is



WHY A
UNIVERSAL JOINT?

Are you following our feature series on

TORSIONAL VIBRATION

Part II
starts on
page 39

ALSO IN THIS ISSUE:

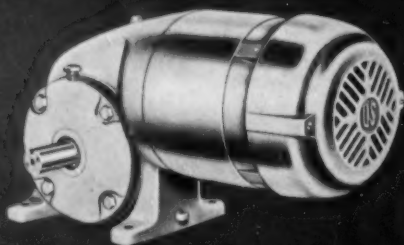
Many motors replace one

Reducer controls compounding mill

STEVENS RICE
UNIVERSITY MICROFILMS
313 N FIRST ST
ANN ARBOR MICH

004620 T1

COMPACT, LOW-SPEED POWER...

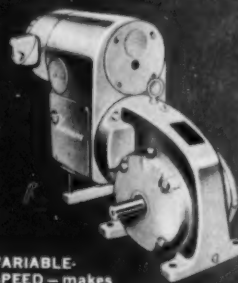


TOTALLY ENCLOSED—for corrosive dust, salt, spray and other damaging environments—provides slow speeds for applications in which ordinary motors require frequent replacement.

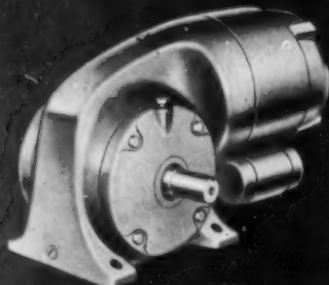
EXPLOSION-PROOF—for volatile fume, explosive dust atmospheres—provides genuine explosion-proof characteristics for hazardous environments. Underwriters' Laboratories approved for Class 1 Group D and Class 2 Groups F and G.



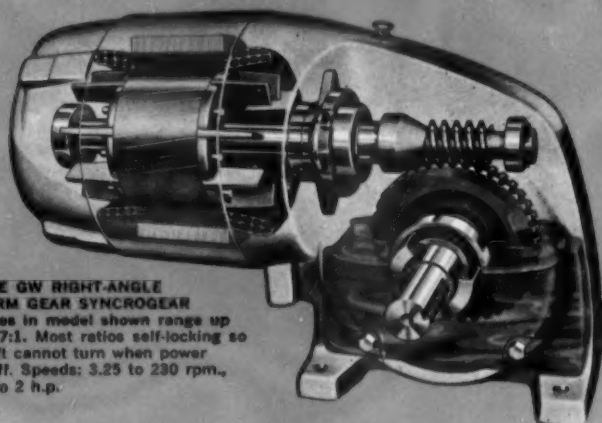
DOUBLE-REDUCTION (GWB)—ratios up to 354:1—with second stage helical gear train—provides steady, multiplied torque and extremely slow speeds for applications in which power-speed precision is important. High-torque case is constructed to resist extra pull.



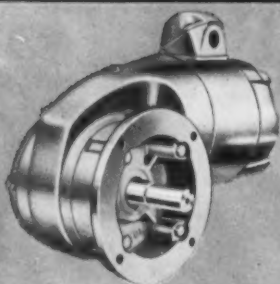
VARIABLE-SPEED—makes instant speed changes by merely turning dial—Combination of GW Syncrogear with U.S. Vari-drive Motor to provide speed control with worm-gear reduction.



SINGLE PHASE (GWR)—can be connected to any 110 or 220 volt line—equipped with capacitor. Single phase is available from $\frac{1}{8}$ to $1\frac{1}{2}$ h.p. Single phase is also available in double-reduction. Type GWB-R.



TYPE GW RIGHT-ANGLE WORM GEAR SYNCROGEAR
Ratios in model shown range up to 87:1. Most ratios self-locking so shaft cannot turn when power is off. Speeds: 3.25 to 230 rpm., $\frac{1}{8}$ to 2 h.p.



FLANGE-MOUNTED (GWV)—for direct connection to driven machine—Footless. Can be direct-connected vertically or on side with shaft right or left.

U. S. SYNCROGEAR/right-angle, worm-gear type

The most economical gearmotor is the right-angle worm-gear type, and it is often the most logical choice for compactness. U. S. SYNCROGEAR Motors, Type GW, offer you such features as compact, strong pyramidal construction and rugged cast-iron case, providing rigidity to handle overhung loads, high starting torques; U. S. Motors' own precision-made gears; one-piece motor worm-gear shaft eliminating connection of motor and worm shafts; and no-rib construction for easy cleaning. Available $\frac{1}{8}$ to 2 h.p. For trouble-free operation... long life... specify: U. S. SYNCROGEAR MOTORS, RIGHT-ANGLE WORM-GEAR TYPE.

U.S. ELECTRICAL MOTORS INC.

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Free illustrated brochure... send for No. F-1971

like a "bread 'n butter" back



maurey drives

keep power
producing at
the pay-off point

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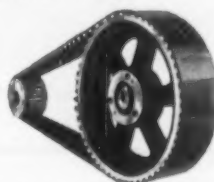
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THE **maurey** LINE
INCLUDES THE DRIVE
THAT'S RIGHT
FOR YOU



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FHP and Multiple



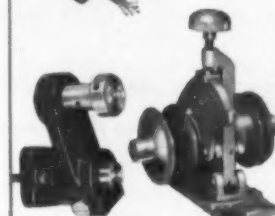
Positive Drives



Super
Wedge Drives



Variable Speed
Drives



hi-g
drive
tensioners

Maureymatic
Variable Speed
Transmissions



Spring Loaded Pulleys



Sprockets,



Roller Chains



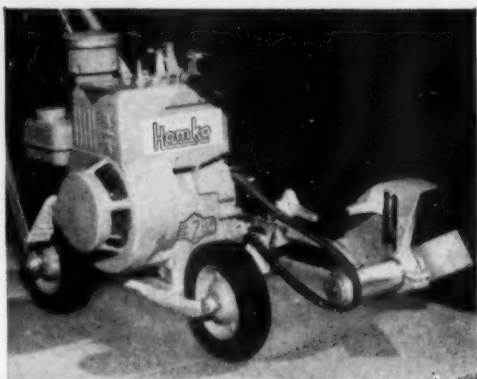
AT THE HEART OF INDUSTRY...



Helping to set a world speed record... a U.S. PowerGrip "Timing"® Belt is the key link in the drive train of this Mercury outboard. U.S. "Timing" Belts' positive tooth engagement prevents slippage, insures perfect synchronization. These belts have high flexibility and strong gripping teeth, are backed by steel cord, permit more compact sheaves, need no maintenance.

TB 103

Wherever the design and production of power equipment is involved, you'll find US Industrial Rubber Products...helping to simplify the design, improving the efficiency and reliability of equipment both new and old, adding to the profit of manufacturer and operator alike.



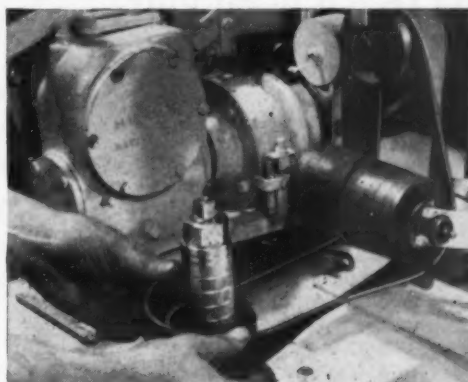
Chosen for overall top performance, U. S. Royal V-Belts drive the edger blade on Western Tool & Stamp Company's powerful Edger-trimmer. These belts must withstand oil, dust, weather, and twisting. They must also deliver top performance at many different engine speeds. U. S. Royal V-Belts do the job... were chosen because they outperformed all competitive belts.

VB 104



Providing better steering control for Clarke's new Power Sweeper, a U.S. PowerGrip Flexible Coupling has eliminated cumbersome, costly metal parts and their need for lubrication... provides quieter, cushioned, yet responsive steering. These easily installed couplings not only compensate for lateral and axial misalignment, but reduce vibration and absorb jarring shocks.

FC 103



"One of the most grueling tests for a rubber belt," describes the job of US Flat Belts for Devere Rotary Power Mowers. These belts transmit power from the horizontal motor shaft to the vertical cutter shaft; perform at 3000 rpm while twisting through a 90° angle; must resist dust, dirt, oil, and gasoline. In addition, a U. S. Royal V-Belt propels the power mower.

FB 101

For every industrial rubber product need, turn to US. For Conveyor Belts, V-Belts, the original PowerGrip "Timing"® Belt, Flexible Couplings, Mountings, Fenders, Hose and Packings... custom-designed rubber products of every de-

scription. Discover why U. S. Rubber has become the largest developer and producer of industrial rubber products in the world. See your U. S. Rubber Distributor or contact US directly at Rockefeller Center, New York 20, N. Y.

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United States Rubber

MECHANICAL GOODS DIVISION

Circle 44 on Reader Service Card

before

after

Gates Industrial News

Gear drive caused chatter marks on parts

GATES SUPER HC DRIVE REPLACES GEAR DRIVE IN LIMITED SPACE... *ends costly rejects*

Chatter marks on parts produced by a vertical boring mill at Manitoba Bridge and Engineering Works, Ltd., in Winnipeg resulted in costly rejects. The cause of the chatter marks was traced to the gear and pinion on the main drive.

About a year ago, the plant engineer investigated the possibility of replacing the gear drive with a flat belt or conventional V-belt drive. However, to do the job, both types of drive had to be too large to fit into the limited space available.

Advised by a Gates Representative, he then designed a Gates Super HC High Capacity Drive for the boring mill. He found that the high capacity Gates Drive was so compact that it could readily transmit the required power in the space vacated by the gears. Now, with the smooth-running Gates Drive, the mill is turning out clean, even cuts, eliminating chatter marks.

The Gates Fieldman located near you is a drive design expert. To contact him for help in designing a new drive, or for quick delivery of replacement V-belts, call your nearby Gates Distributor.

Building the future
on 50 years
of progress



The Gates Rubber Company
Denver, Colorado

BP39

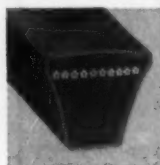
Gates Super HC High Capacity Drives replace gear and flat belt drives

Designing a new Drive? Gates High Capacity Drive saves space and money ... cuts bearing loads

When you design a new drive or replacement drive, you can save space, weight and money by using a Gates Super HC V-Belt Drive—the first and most advanced high capacity drive. Because of exclusive design features, this new Gates Drive can often transmit the required horsepower in about half the

space needed by a conventional V-belt drive—with fewer belts and smaller sheaves.

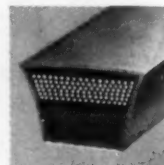
Drive costs are reduced as much as 20%. Drive weight is reduced 20% and more. Guards and machine housings can be smaller, shafts shorter. Reduced weight and overhang on bearings cut bearing loads. Moreover, the Gates Super HC Drive can operate at belt speeds up to 6,000 ft/min without dynamic balancing!



Need replacement V-belts? Why Gates Hi-Power V-Belts are industry's No. 1 choice today

The exclusive construction features of Gates Hi-Power V-Belts—Concave Sides, (U.S. Pat. 1813698) Precisely-Engineered Arched Top, Flex-Bonded Tensile Member—make them more dependable than ordinary conventional V-belts, giving you far longer belt life on even the toughest applications.

Moreover, because of Gates high standards of quality control, you get a perfectly matched set of Hi-Power V-Belts every time—every belt pulls its share of the load throughout the long service of the drive, further increasing belt life.



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POWER TRANSMISSION DESIGN[®]

OCTOBER 1961

volume 3 number 10

THE MAGAZINE OF MACHINE DRIVES

FEATURES

- WHY A UNIVERSAL JOINT** 21
Covers types, operating angles, basic principles of selection and installation, and gives three typical case histories.

- MANY MOTORS REPLACE ONE** 28
Savings of 50% resulted from replacing a single motor system with direct driven rollers.

- SPEED REDUCTION LEADS TO ECONOMICAL MOBILE GENERATOR** 30
Drive details of a British gas turbine-powered generator on wheels.

- SECOND SHAFT SIMPLIFIES STEERING** 34
Electric ram truck has two drive shafts, each with its own motor differentially-controlled.

- REDUCER CONTROLS COMPOUNDING MILL** 36
Unusual application of double reduction speed reducers to control thickness of plastic sheet.

- TORSIONAL VIBRATION PART 2—MULTI MASS SYSTEMS** 39
By T. W. Spaetgens
Includes case history of hydroplane motor whose average shaft life was two hours.

BEARING SECTION

- TFE TAPE LINED BEARINGS** 44
Some of the uses, types and advantages of filled Teflon resin bearings.

DEPARTMENTS

- | | | | |
|--|----|--|----|
| LETTERS | 8 | *PRODUCT NEWS | 46 |
| NEWS | 10 | *FREE REFERENCE MATERIALS | 50 |
| MEETINGS | 13 | *LITERATURE | 60 |
| POWER TRANSMISSION AT WORK | 14 | MEN | 64 |
| BEARING BUSINESS | 43 | ADVERTISERS INDEX | 66 |



FACTS AT YOUR FINGERTIPS:

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and— another NEW product from

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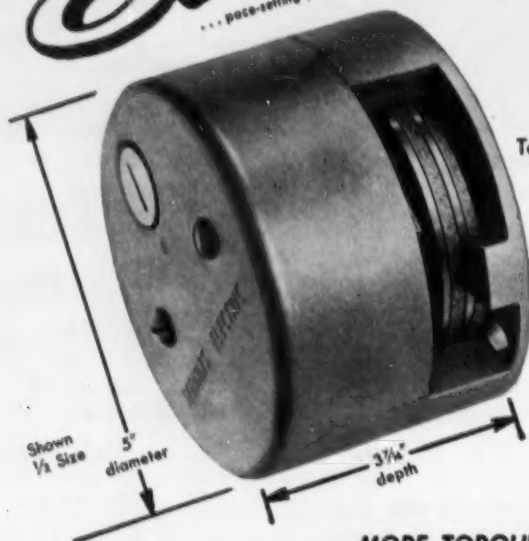
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**NOW AVAILABLE—
NEW SIZE H-44
electro-magnetic
DISC BRAKES**

Prompt
Shipment

Torque—3 lb.-ft. max.
Weight—5½ lb

Exclusive
Stearns
unitized
construction,
and
"Visi-Wear-
Indicator"



**MORE TORQUE PER POUND...
MORE TORQUE PER CUBIC INCH!**

THE NEW STEARNS "H-44's" are spring set—solenoid released disc brakes that mount on NEMA "C" flanges of "40 frame" fractional hp electric motors . . . provide fast, smooth, quiet stops—"failsafe" operation . . . combine higher torque with minimum size and weight.

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Specify THE NEW STEARNS "H-44's" with complete confidence—they have been fully life-tested, and *Installation-Proved* for long, trouble-free, dependable operational life with a minimum of maintenance.

Request Stearns New Product Preview 1-61-B



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The Complete Line of Electro-magnetic Clutches — Brakes — Clutch-Brakes

SINCE 1917—THE CHOICE OF LEADING MOTOR AND MACHINERY MANUFACTURERS

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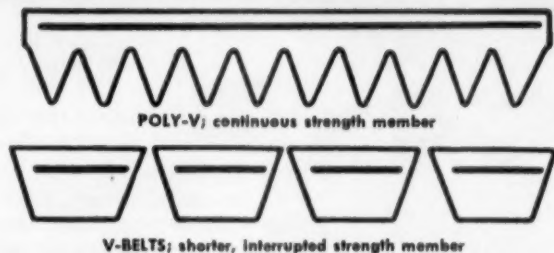
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POWER TRANSMISSION DESIGN



"MORE USE PER DOLLAR"

Poly-V Belt is a single unit with even, uniform pull. Uninterrupted strength member gives much higher hp capacity per inch of drive width. No belt drive delivers as much power in the same space as Poly-V!

Steel Mill Converts to R/M POLY-V BELT on Rugged Hot-Saw Drive!

A 34½" wide R/M Poly-V® Belt of 92 ribs now delivers "power plus" on this punishing hot-saw drive at one of the country's largest steel works. Converting to Poly-V eliminates the problems of a multiple V-belt drive . . . matching, stretching, overloading, whipping and snapping of individual V-belts.

The patented Raybestos-Manhattan Poly-V Drive is a single unit, V-ribbed belt design that mates perfectly with Poly-V sheave grooves, eliminates V-belt stretch and length matching problems . . . reduces costly machine downtime and production slowdowns for individual belt replacement. Sheave

ratio and belt position remain constant from *no load to full load* . . . assure smooth, *complete* power delivery under the toughest drive conditions. Poly-V Belt can't sink in the grooves under surges of load. This means less wear on belts and sheaves . . . and much more power in the same space as a multiple belt drive—or equal power in much less space!

Just two Poly-V Belt cross-sections meet every heavy duty drive requirement. Let an R/M representative show you how Poly-V Drive can give you greater power-packed performance and drive dependability . . . "More Use per Dollar" than the drive you now use. Write for Bulletin M141.

When You Change Drives . . . Convert to R/M Poly-V Drive and Be Sure!

RAYBESTOS-MANHATTAN, INC.
MANHATTAN RUBBER DIVISION, PASSAIC, NEW JERSEY



RM1020
ENGINEERED
RUBBER
PRODUCTS
... MORE USE
PER DOLLAR

Whatever your driven machine,
you save it from RUIN
every time this clutch cycles...



HILLIARD Adjustable Slip Clutch

- * Safely limits torque
- * Protects against overload-jams - downtime
- * Resumes drive automatically after overload
- * Eliminates shear pins and lost time
- * Adjustable-while-running feature available

"Value is related to function—not to cost."

Hilliard Slip Clutches give you continuous, positive, and reliable protection of drives on packaging machines... case loaders... conveyors... dishwashing machines... printing presses... circuit breakers... and many others.

They also maintain steady torque while permitting speed variation on fabric drying drums, steel strip slitters and similar equipment.

Adjustable-while-running types maintain constant tension on rewind stands for paper coaters, textile machines, rope, steel and wire mills and for drive systems requiring overload protection but which must be disconnected at times.

Write for Bulletin 300 for complete details.

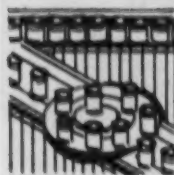
Remember, HILLIARD is your Industrial Clutch specialist... for more than 55 years... and the line includes Over-Running Clutches, Intermittent Drive Units, Single Revolution Clutches, Hilliard-Twiflex Centrifugal Coupling.

Manufacturing Clutches for over 50 years

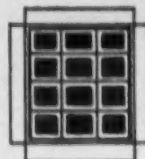
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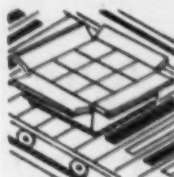
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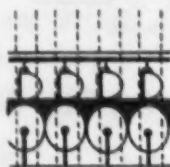
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LETTERS

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811 Huron Road, Cleveland 15, Ohio

Belt drive pulley systems

In your August Belt Drives issue, page 22, an application of a variable speed drive is shown in which the spring-loaded pulley is moveable. You say that as the diameter of the pulley is decreased, the speed is increased. This would be true if the spring-loaded pulley were driven and the fixed diameter pulley did the driving.

In my experience, this setup is very seldom used. Usually, the spring-loaded pulley is mounted on the driving motor and the fixed diameter pulley is mounted on the driven equipment. Thus a reduction in the diameter of the variable diameter pulley would slow down the driven equipment.

This distinction in the mounting is important to the operation of this type of pulley.

However, thanks for the clear and worthwhile information you are publishing.

CHARLES P. ROYER
895 Clifton Ave.,
Glen Ellyn, Ill.

You are quite correct that the set-up illustrated is rare. However, in the illustrations at our disposal, the spring loaded sheave was shown as moving, so we suited the caption to the case. In the matter of semantics, we disagree with you. Our caption only refers to the spring loaded sheave, so we say "by moving the controllable sheave... (its) speed (is) increased."

Torsional Vibration reprints

I would appreciate receiving a reprint of the article on "Torsional Vibration", which appeared in the Sept., 1961 issue of POWER TRANSMISSION DESIGN.

LOYD W. REAM
Project Engineer
Hercules Motor Corp.
Canton, Ohio

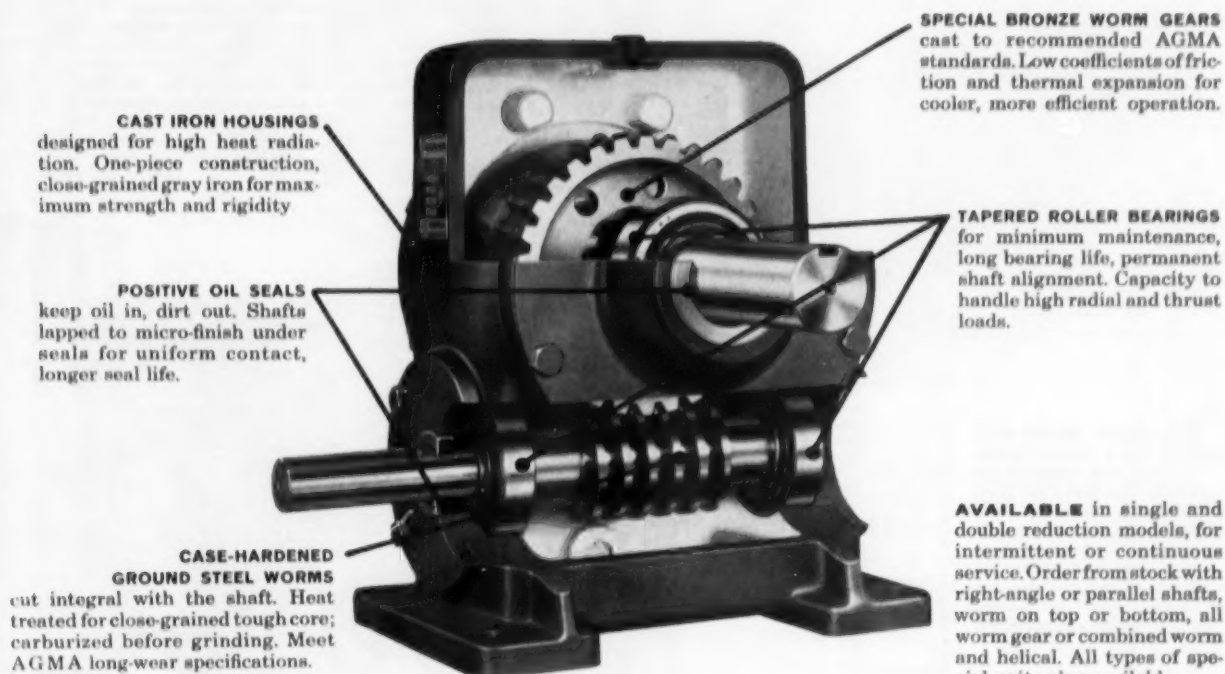
This four-part article will be reprinted in its entirety after the last part appears in our December, 1961 issue. (See announcement on page 48 for details of how the subject has been divided.) Until then we can only offer a limited number of tear-sheets.

POWER TRANSMISSION DESIGN

Engineering Data



WINSMITH "C" SERIES WORM GEAR SPEED REDUCERS



- 108 Models
- 1/100 to 34 H.P.
- Ratios 5:1 to 4460:1
- Max. Output Torque
142 to 34,767 in. lbs.

Winsmith "C" Series Reducers are compact units which offer a wide range of horsepower and torque output in minimum space. Their design and construction provides high shock load resistance; maximum thermal capacity without induced cooling; greater overhung load capacity; all moving parts totally enclosed in a dirt-proof housing and lubricated from a central oil bath; and complete interchangeability of major components. These features add up to smooth, trouble-free performance—an extremely low rate of wear—high mechanical efficiency—and greater overall economy per horsepower dollar.

For complete information on Winsmith Speed Reducers, write today or call your nearest Winsmith Representative. You'll find one in every major industrial area, listed in the Yellow Pages. They are technically trained experts who are always ready to help you with any speed reducer problem. For both standard and special power transmission applications, you'll find it pays to standardize on Winsmith.

WINSMITH, INC.

204 Eaton Street, Springville, (Erie County), New York



• • • Winsmith Speed Reducers are made by American craftsmen to meet American design and production standards.

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NEWS

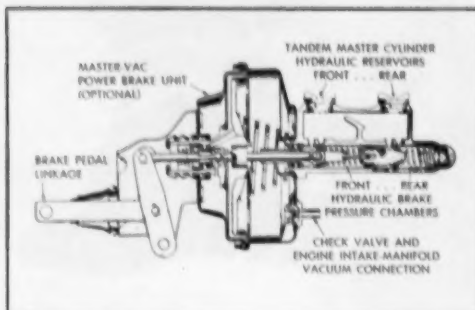
FROM THE POWER TRANSMISSION FIELD

'62 Rambler: new suspension, tandem brakes



ALL 12 MODELS in the Rambler 100-in. wheelbase series, including sedans and a two-door convertible, have redesigned front suspension and a self-adjusting tandem brake system. Other features: an optional automatic clutch transmission called "E-Stick"; a more compact automatic transmission, using a torque converter with less hydraulic spin loss.

STANDARD BRAKE SYSTEM has a tandem master cylinder and separate hydraulic systems for front and rear brakes. If either front or rear brakes develop a hydraulic failure, the other set allows the driver to stop the car with ease. The unit is mounted in the engine compartment.



FRONT SUSPENSION provides better control and stability. The long coil springs are retained, but a single lower control arm with outer ball joints and a rear facing radius rod have been added. Caster and chamber adjustment is provided on the upper control arm pivot bolts.



Conference will discuss space-age lubrication

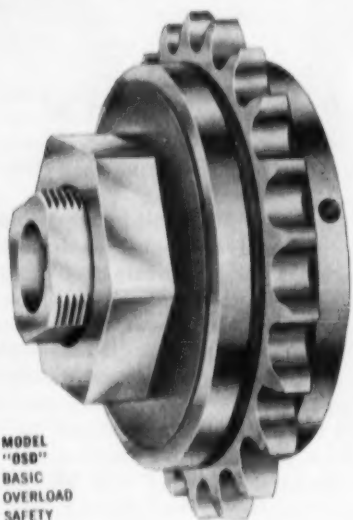
The Eighth Annual Lubrication Conference is being jointly sponsored by the American Society of Lubrication Engineers and the American Society of Mechanical Engineers. It will be held on Tuesday, Wednesday and Thursday, October 17, 18 and 19, 1961 in Chicago, Illinois, at the Morrison Hotel.

This conference is the only annual meeting devoted exclusively to research and development studies in the field of lubrication. Lubrication for the space age requires scientific understanding of materials and designs in unusual and extreme environments.

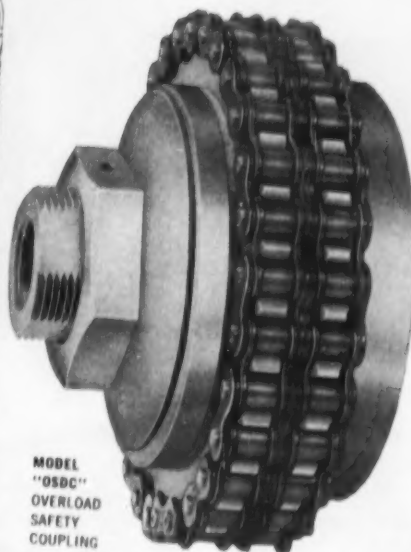
Topics will consider the influence of nuclear radiation, vacuum of outer space, extremely high and extremely low (cryogenic) temperatures on lubrication. Lubrication, friction, wear and endurance for rolling element bearings and other machine components will be described. Properties of lubricants papers will include boundary film interface phenomena and the latest developments in super-refined mineral oils. Potential use of magnetic fields for bearings, as well as gas film bearings, offer interesting possibilities.

The final program is being mailed to members of the

INSURE AGAINST COSTLY DOWN-TIME!



MODEL
"OSD"
BASIC
OVERLOAD
SAFETY
UNIT



MODEL
"OSDC"
OVERLOAD
SAFETY
COUPLING

DALTON OVERLOAD SAFETY DEVICES

Prevent breakdowns
due to jamming!

Dalton Overload Safety Devices are torque-limiting units that prevent costly breakdowns and excessive wear of equipment due to overloading by automatically dis-engaging when a set maximum load is reached. They are re-engaged automatically when the overload is eliminated. The devices are easily adjusted with a torque wrench to a specific maximum torque load.

MODEL "OSD"

Basic Overload Safety Device unit to be used with a sprocket, gear, belt-pulley or flange.

MODEL "OSDC"

(Overload Safety Device Coupling)

Provides overload protection through use of a basic OSD unit combined with a roller chain coupling half counterbored to fit the OSD flange. Standard double-width roller chain couples the basic OSD unit and the coupling half.

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OSD CATALOG 961

DALTON CAN SUPPLY ALL YOUR PRODUCTION GEAR
AND SPROCKET NEEDS. SEND FOR QUOTATIONS.

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SPROCKETS



GEARS



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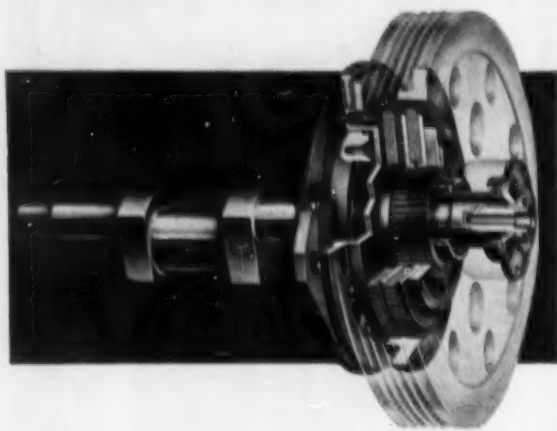


TIMING
BELT
SPROCKETS



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MINSTER Clutches for Press Conversions

A Minster Clutch conversion is the most profitable way to increase press efficiency because it will

- eliminate downtime caused by clutch failure
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Minster conversion units, made by a press manufacturer who knows your problems, are standard clutches individually applied to your press. Complete with flywheel and shaft, ready to drop into place. Thousands in daily use.

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MINSTER®

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NEWS

ASLE and the ASME Lubrication and Machine Design Divisions as well as to others having known interest. Additional information may be obtained from the Headquarters of either Society or the Planning Committee Chairman, Robert L. Johnson of NASA-Lewis Research Center, 21000 Brookpark Road, Cleveland 35, Ohio.

"Learn from the mistakes of others . . ."

. . . you can't live long enough to make them all yourself".

These words of wisdom will be the keynote to the Mechanical Power Transmission Equipment Distributors Association 1961 Convention (Chicago's Edge-water Beach Hotel, October 23, 24, 25). Meetings with manufacturers, panels and discussion groups will stress the benefits of mutual education for both efficiency and profits. Subjects will range from a discussion of sales training responsibilities for both distributor and manufacturer, to the Association's profit sharing plan.

Registration fee is \$45 per member \$60 for non-members. Registration forms from MPTEDA, 1028 Connecticut Ave., N. W., Washington 6, D. C.

Winners in Hydraulics Prize Paper Contest

Cash awards totalling \$1400 will go to winners of the annual HYDRAULICS & PNEUMATICS Magazine Prize Paper Contest (announced in POWER TRANSMISSION DESIGN in June).

Winners of the top three prizes are: 1st (\$500), Willis J. Taylor, *Interlocking Air Circuits for Reliable Sequencing*; 2nd (\$300), Grady Gilder, Jr., and George K. Fling, *Techniques for Designing Airborne Components*; 3rd (\$200), E. H. Fletcher, *Closed Circuit System Powers Tractor's Hydraulics*. There were four other prizes of \$100 each.

Awards will be presented at the National Conference on Industrial Hydraulics, Oct. 19, Sherman Hotel, Chicago. These prize winning papers are published in the October issue of HYDRAULICS & PNEUMATICS.

Business news in brief

. . . Extremultus Inc. named Greenville Textile Supply Co., S. C., a new distributor for their power transmission belting.

. . . American Biltrite Rubber Co., Boston Woven Hose and Rubber Div., appointed Mahoning Valley Supply Co., Cleveland, a warehousing distributor.

. . . American Pulley Co. made Mill Equipment Sales Co. a franchised distributor of their transmission equipment for the Ohio, Michigan, Indiana and Illinois grain industries.

MEETINGS

OCT.

9-13 **Society of Automotive Engineers**—National Aeronautic Meeting, The Ambassador Hotel, Los Angeles.

10-12 **American Standards Association**—12th National Conference on Standards, Rice Hotel, Houston, Texas.

16-18 **American Institute of Electrical Engineers**—1961 Machine Tools Industry Conference, Rockford, Ill.

17-19 **American Society of Lubrication Engineers**—8th Joint Lubrication Conference, Hotel Morrison, Chicago.

23-27 **American Society for Metals**—43rd National Congress and Exposition, Cobo Hall, Detroit.

23-25 **Mechanical Power Transmission Equipment Distributors Association**—Annual Convention, Edgewater Beach Hotel, Chicago.

23-26 **The Metallurgical Society of AIME**—Fall Meeting, Pickfort Shelby Hotel, Detroit.

Nov. 1

American Gear Manufacturers Association—Semi Annual Meeting, Edgewater Beach Hotel, Chicago.

Nov. 1

National Lubricating Grease Institute—29th Annual Meeting, Rice Hotel, Chicago.

NOV.

7-10 **Packaging Machinery Manufacturers Institute Show of 1961**—Cobo Hall, Detroit.

13-18 **International Factory Equipment Exhibition**, London, England.

13-18 **Engineering Materials and Design Exhibition**, London, England.

Browning COMBINES THE POSITIVE ACTION OF GEARS

With THE FLEXIBILITY OF BELTS

NEW



GEARBELT DRIVES

GEARBELT ADVANTAGES:

- ▶ **A POSITIVE DRIVE.** No slip, creep or backlash.
- ▶ **STEEL CABLE** strength member will not stretch, needs minimum take-up.
- ▶ **FREEDOM** from high initial belt tension. Reduces bearing loads, increases life.
- ▶ **COMPACT.** Gearbelts permit smaller pulleys, shorter centers, narrower belts.
- ▶ **LIGHTWEIGHT.** High horsepower-to-weight ratio.
- ▶ **LESS NOISE.** No vibration, no chatter.
- ▶ **LESS HEAT** because virtually no friction.
- ▶ **SPLIT TAPER BUSHING** grips pulley on shaft with vise-like pressure. Quick, easy mounting and removal.

Here is a versatile new drive that provides high mechanical efficiency *plus* the inherent flexibility of belts. Browning Gearbelts engage matching pulleys with the positive action of gears, yet without their disadvantages. They eliminate metal-to-metal contact, lubrication, vibration, chatter. Require minimum maintenance.

Browning Gearbelt Drives provide cost-saving advantages in scores of applications, particularly those which require high capacity in limited space, or freedom from stretch and take-up. Ask your Browning distributor for complete information, or write us for Catalog GB-201.

Browning Manufacturing Company
Maysville, Kentucky

Browning... OUR 75th YEAR

Circle 48 on Reader Service Card

POWER TRANSMISSION DESIGN

AT WORK

Variable-speed drive for indoor skiing



Skiing on a power-driven ski slope gives the sensation of skiing on real snow. Ski-Dek Corp., Caldwell, N. J., makes this indoor ski slope. It works as a combination

treadmill and belt conveyor. Skiing surfaces always move upward. Speed of the moving slope can be varied continuously.

The drive is a 15-hp electric motor with a variable-speed sheave mounted on the motor drive shaft. The companion pulley is on the drive shaft of a shaft-mount speed reducer. The speed reducer has a swinging speed-change handle. This handle, shown left, contains slots which fit over pins in different positions along the handle swing.

Handle movement swings the shaft-mount reducer and moves the companion pulley forward or backward. The movement alters the pitch diameter of the sheave,



AT WORK!

Look for this new feature in coming issues. It will bring you ideas and techniques for your use—at work.

thereby changing the speed ratio. Maximum speed is at maximum pitch diameter. It occurs when the distance between the two pulleys is at a minimum.

Toothed belt stops slip on 90-foot lathe

A toothed timing belt, used to drive a 90 foot trepanning lathe, eliminated the tool marks produced by slipping V-belts. The lathe, for turning down special steel rollers and other large jobs, now turns smooth finished work, and is easier to maintain.

The mammoth machine-tool is driven by a 40-hp shunt-wound variable-speed motor, 500 to 1500 rpm. The toothed-belt drive which replaced the V-belt drive is of double extra heavy pitch (XXH). Pitch of the grooved motor pulley is $\frac{1}{4}$ -in., with a pitch diameter of 7.162-in. and a face width of 5-in. The driven pulley has a pitch diameter of 28.648-in. to provide a 4:1 speed ratio. The toothed belt has a pitch length of 160-in. for a recommended center distance of 50.734-in.

This type of drive ended the slippage because the belt teeth fit into mating pulley grooves, with a minimum tooth-to-groove clearance. Operation is almost noiseless. Streck's Inc., who own the lathe plan on changing several more drives on smaller lathes to toothed belts. The drive was made by T. B. Wood's Sons Co.

Submerged coupling needs no care

A flexible coupling ran continuously under water for three years



**THIS IS THE
50 DEGREES
OF EXTRA
HEAT-RESISTANCE
THAT KEEPS
BOSTRON V-BELTS
WITH NEOPRENE
OPERATING LONG
AFTER CONVENTIONAL
V-BELTS FAIL**

Excessive heat build-up caused by constant flexing — even in environmental temperatures — is the major cause of V-belt deterioration. BOSTRON with Neoprene remedies this problem.

Neoprene withstands heat up to 165°F. (ordinary belts deteriorate at as low as 115°F.), and gives greater resistance to oils, ozone, chemicals, abrasion. This means a high safety margin, long life.

Neoprene with Fiber-Dispersed Stock in BOSTRON's compression member provides: (1) high cross-wise rigidity, (2) exceptional length-wise flexibility, and (3) extra tensile member support. Fibers are closely packed, in straight lines, and virtually frictionless.

BOSTRON's Tensile Member, by actual test, gives greater stability, 40% more strength, and is inherently stretch resistant. Moisture gain is only 1/20th that of conventional reinforcing fiber. A special heat and tensioning process for the cords further minimizes stretch. BOSTRON withstands more shock loading, needs less maintenance, and shows minimum growth even after months of operation.

Inside and out, your best buy is **BOSTRON V-BELTS with NEOPRENE**



AMERICAN BILTRITE RUBBER COMPANY
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BOSTON 3, MASSACHUSETTS

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INDUSTRIAL HOSE



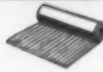
BELTING



V-BELTS



PACKING



MATTING



TAPE

WHATEVER YOUR TRANSMISSION NEEDS



MULTIPLE STRAND CHAIN



ATLAS HAS THE RIGHT ANSWER

A. S. A. ROLLER CHAIN
MULTIPLE STRAND CHAIN
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OFFSET SIDEBAR CHAIN
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SPROCKETS
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Atlas has the right chain for your power transmission or conveying needs. All are unsurpassed in quality . . . pre-tested to give better service. Atlas Chains are made in all sizes . . . in steel, stainless steel, bronze and Electrolyzed finish.

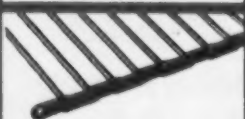
For complete details and technical assistance on your chain design or maintenance problems there's an Atlas Engineer to help you. Get in touch with your local Atlas Distributor or write direct for details and catalog to Atlas Chain & Manufacturing Company, West Pittston, Pa.



EXTENDED PITCH CHAIN



ATTACHMENT CHAIN



SPECIAL CHAIN



OFFSET SIDEBAR CHAIN



NEW POWER DRIVE CALCULATOR

Technical data for selection of roller chain and sprockets in slide rule form. Available to engineers upon request.

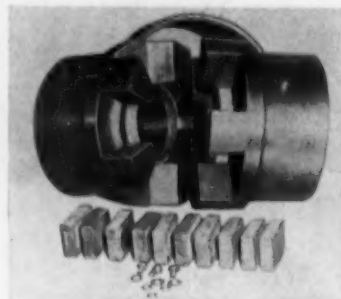


ATLAS

AT WORK

without maintenance. The coupling even runs under oil, mild chemicals, and corrosives.

Body of the coupling is a semi-steel casting. The outside collar and inside sleeves are hot-dipped galvanized. Set screws, lockwashers, and retaining bolts are stainless steel. Cushions are Bakelite. Processing the cushions includes boiling them in water for five days. This prevents swelling, shrinking, or distortion after installation.



The coupling contains no intricate mechanisms. Installation takes minutes—using only a straight edge. Metal jaws don't wear out because the load is transmitted through the cushions. Horsepowers range from 2.6 to 1365 at 100 rpm. Bore sizes are from solid to 9 1/2 in. Made by Lovejoy Flexible Coupling Co., Chicago.

Tiny transmitter measures shaft horsepower



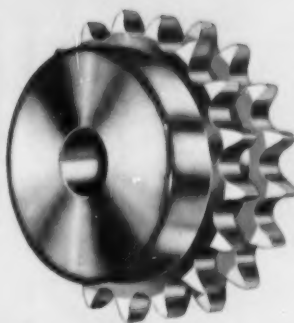
From 2 1/2-tons to 3 1/2-lb gives an indication of the size difference between conventional propeller shaft-hp measuring equipment and this miniature RF-transmitter unit. It mounts directly on the shaft and transmits readings accurate within 1 percent.

The electronically-sensed torque and rpm signals are mixed and

Circle 6 on Reader Service Card

POWER TRANSMISSION DESIGN

**STEEL HUB
SPROCKETS** for single
or multiple width chains,
completely machined to
the highest standards.



Everything in Chain Drives from to

Cullman Sprockets and Roller Chains

You can be sure of meeting virtually every power transmission requirement with CULLMAN SPROCKETS AND ROLLER CHAINS — a complete selection of types and styles developed from almost 70 years' experience. Need specials? Here too, Cullman can serve you by manufacturing to your specifications. A national network of distributors and sales engineers, backed by regional warehouses, is always ready to serve you.

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interchangeable hubs
and bushings.

STEEL PLATE SPROCKETS

for single or multiple width
chains can be supplied plain,
with drilled or tapped holes,
counterbored or split.

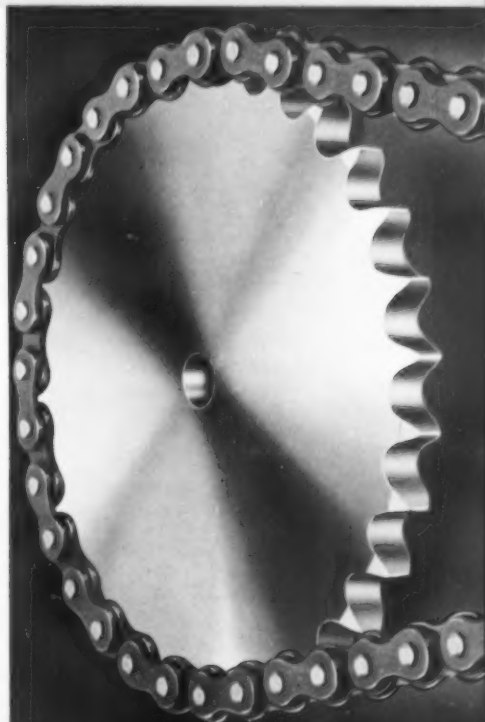
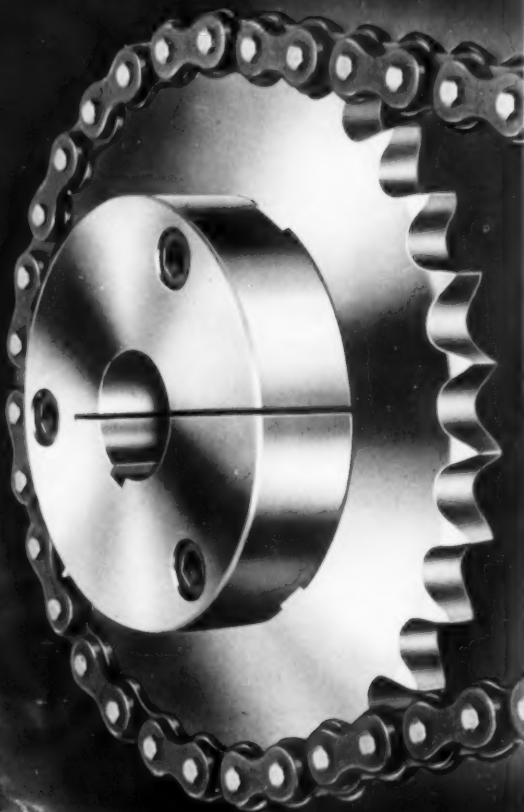
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literature . . . get assistance
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transmission problems.

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Roller Chain Drives Since 1893



1 HIGH-SPEED OPERATION

Balanced release levers permit high-speed drives. Lever "throwout" is eliminated for longer bearing life. Patented anti-friction rollers give instant release with minimum pedal pressure.

2 ACCURATE FIT

Close-tolerance drive between cover and pressure plate assures smooth starts. Highly accurate bolt circle fits flat flywheels—accurate outside pilot diameter fits counterbored flywheels.

3 VIBRATION DAMPENER

Coil-spring vibration dampener absorbs vibrations between engine and transmission. Noise, rattle and thrash in the gear train are eliminated for smooth, quiet clutch operation.

**ROCKFORD
SPRING-LOADED
CLUTCH**


International model C-130 Dump Truck equipped with Rockford Spring-Loaded Clutch

**4 HIGH-TORQUE DESIGN**

Powerful engagement springs, properly spaced over the facing area, assure maximum driving contact. Compact, low-inertia design prevents gear clashing and delayed shifting.

5 SMOOTH ENGAGEMENTS

Dynamic and static balancing assures you of smooth, enduring clutch performance. Both driving and driven members are balanced to eliminate vibration.

6 HIGH-TEST FACINGS

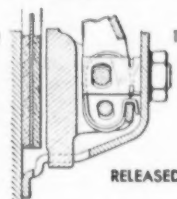
Using only the highest quality facings, Rockford Clutches give extra-long clutch life, provide cushioned starts, reduce scoring and greatly cut costs of downtime replacement and labor.

7 PERFECT ALIGNMENT

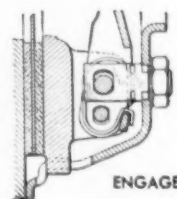
Close-tolerance splined hub assures perfect disc alignment. Through-hardened hub gives long life. Precision manufacturing and rigid quality control eliminate chances for misalignment.

7 Good Reasons Why Idea-Men Count on Rockford Reliability

Above are seven reasons why more and more design men specify Rockford Spring-Loaded Clutches. Equally important, ROCKFORD RELIABILITY is due to 63 years of creative engineering, precision manufacturing and rigid quality control. Rockford offers complete design engineering service at no cost or obligation. You're backed by a worldwide service network. Write today for complete details on ROCKFORD RELIABILITY.



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DIVISION
OF
BORG-
WARNER

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AT WORK

amplified. This causes a frequency deviation of a sub-carrier oscillator which is fed to a frequency modulated transmitter. The signal is received by a VHF-FM receiver. It is then discriminated to obtain the sub-carrier frequency and discriminated again to produce an output signal proportional to frequency deviation. The output signal is amplified and fed to the read-out recorder.

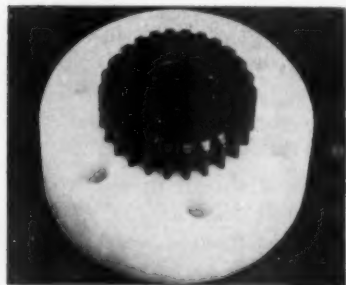
The speed, size and location of the shaft determines the package for a particular job. On a ship's propeller shaft, for example, the instrument would fit into less than six inches.

Called the Thor Power Meter, it's made by Unilectron, Inc. of Cambridge, Mass.

Plastic coupling stops wear and noise

Substituting a nylon coupling for a steel coupling stopped excessive wear and noise of a compressor drive for a refrigerator.

The original steel coupling and its mating gear wore rapidly. Backlash and vibration accelerated the wear between the gear and coupling when the engine changed speeds to regulate the compressor. This wear caused chatter between the two parts. Noise became excessive after 100 hr of continuous operation.



The plastic coupling stopped the wear, ran quietly even after 500 hr of continuous operation.

Coupling made by Polymer Corp., Reading, Pa.

Wood's stationary control, variable speed drives, including SVS types, are available in capacities from fractional to over 300 hp using conventional v-belts. Wide range VPS types are available in capacities from 1 to 20 hp.

Write for BULLETIN 6102.



T. B. WOOD'S SONS COMPANY • CHAMBERSBURG, PENNSYLVANIA

ATLANTA • CAMBRIDGE • CHICAGO • CLEVELAND • DALLAS

SVS/2361

Circle 53 on Reader Service Card



Compact, Dependable, Quiet and Powerful



that's what The Pfaudler Co. demands of gear reducers used for the agitator drives on their glassed-steel and alloy mixing vessels. That's why Pfaudler specifies Cone-Drive double-enveloping worm gear reducers for their line of TW Agitation Drives.

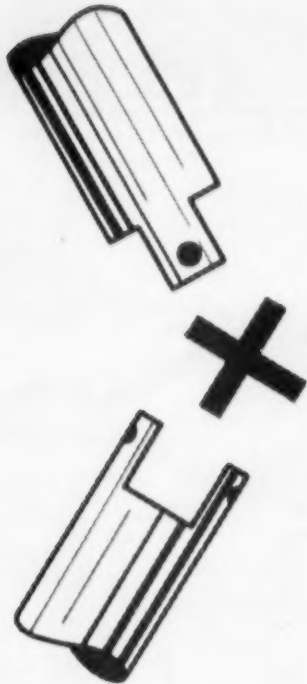
Cone-Drive gear reducers are available in capacities up to 60 HP and with 27 standard output speeds from 7.3 to 525 rpm (with 1750 rpm motor). Gear reducers can be hollow-shaft or solid shaft for left-hand, right-hand or vertical mounting.

Hollow-shaft gear reducer shown in the application above has a 5" center distance and 30 HP maximum rating. Fan cooled models are available for increased thermal capacity. If maximum thermal HP capacity is required (equal to full mechanical HP ratings), water cooling coils may be installed.

CONE-DRIVE GEARS DIVISION MICHIGAN TOOL COMPANY

7171 E. McNichols Road • Detroit 12, Michigan • Telephone TWinbrook 1-3111

Circle 49 on Reader Service Card



Why a UNIVERSAL JOINT?

- *They're low in first cost*
- *Simple in design*
- *Little trouble to maintain*

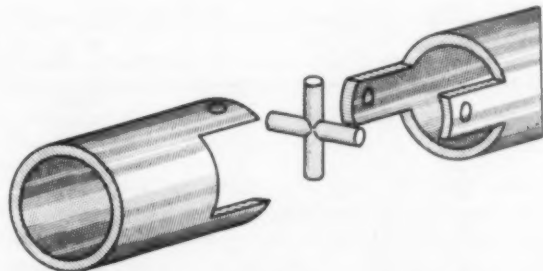
WHEN DRIVING AND DRIVEN SHAFTS are not alined, some sort of flexible coupling must be used to transmit power from one to the other. If the coupling must transmit a high torque, and there is likely to be severe misalignment between the driving and driven shafts, universal joints are the solution.

A simple form—A universal joint is a special type of flexible coupling. A very simple form of it in figure 1, consists of the two shafts shaped, and drilled at right angles, connected through a third piece. The third piece could be two shafts, of the same diameter as the holes, welded together to form a cross. Many variations of this joint are in use, some highly complicated. Basically, however, they are all gimbal joints. They are able to transmit power through angles up to 45 degrees and torque over 2,000,000 lb-in.

Disadvantages of the simple type—This simple, single universal joint has these big drawbacks.

1. It cannot transmit power from one shaft to another which is parallel, yet offset from it.

2. The velocity of the second shaft varies harmonically with each revolution of the first.
3. As the angle of misalignment changes, the distance between driving and driven units must also change.



1. SIMPLE UNIVERSAL JOINT, incorporating the simple cross and journal bearing.

Types of joints—Simple solutions have been devised for each of these three disadvantages. For the

Table 1
Limiting operating angles

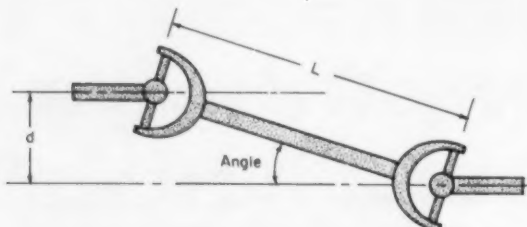
Speed-rpm	Max. operating angle-deg.
1,000	15
2,000	12½
3,000	8½
4,000	6½
5,000	5

Table II
Fluctuation of speed

Operating angle-deg.	Fluctuation-percent of rpm
2	0.15
4	0.5
6	1.1
8	2.0
10	3.0
12	4.4
14	6.0

Table III
Offsets for double universal joints

When a slip joint is to be included in the system, it should be placed between the two universal joints for maximum effectiveness.

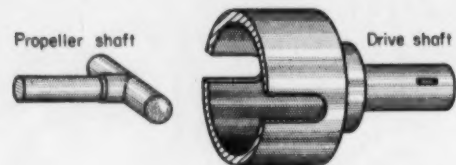


$$\frac{d}{L} = \text{Sine (angle)}$$

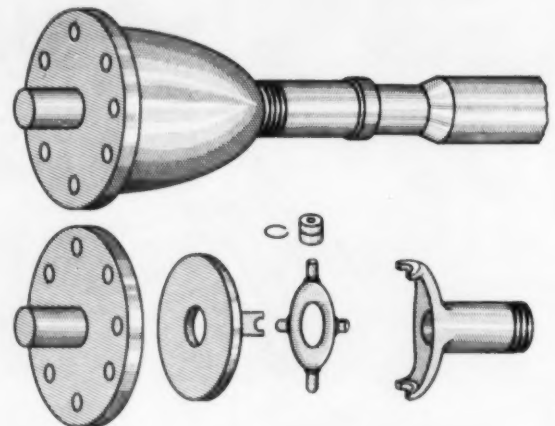
Angle - deg.	d - in. (for L = 100-in.)
1	0.029
2	0.058
3	0.087
4	0.116
5	0.145
6	0.174
10	0.291
15	0.436
20	0.582
30	0.873
45	1.309

TO FIND the offset "d" for other values of L, use arithmetic proportioning. That is, for L = 50, when angle of offset is 5 deg, d = 0.073.

EVERY VARIATION



THE BLOCK AND TRUNNION TYPE is a simple, but relatively inefficient coupling. It is usually protected from dirt with a cover, which doubles as a grease retainer. The roller joint is a similar device, but the fork slots have two sliding blocks for the rollers. This enables the rollers to be more tightly fitted, and hence reduces wear in the coupling.



A RING UNIVERSAL JOINT, in which the cross has been replaced with a ring. The driving flange, is covered with a casing. The larger shaft fits over splines on the smaller one, to provide longitudinal movement. The ring, technically, is known as a journal. This joint design is common in the automotive field; it is economical and sturdy. It requires grease lubrication about every 50-100 hours of operation. Courtesy Watson-Spicer Co.

first, the double universal joint is used. For the second, constant-velocity joints are available, or a double simple universal joint may, under certain circumstances, be used in the same way. And where the angle of this misalignment will change, (the 3rd disadvantage), many universal joints incorporate splined slip joints.

BASIC DESIGN OF SIMPLE UNIVERSAL JOINTS

Although universal joints can be used with operating angles up to 45 deg., maximum power will be transmitted if the included angle is kept below 8 deg. For minimum power losses, the two shafts should operate in the same plane and the angles should be

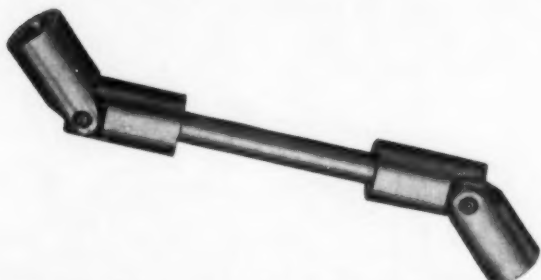
SERVES A PURPOSE



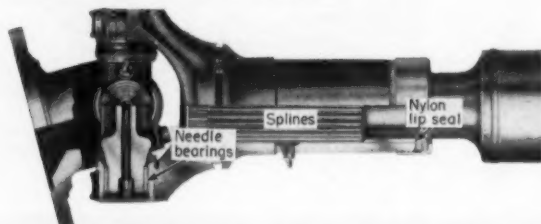
SINGLE UNIVERSAL JOINT—Courtesy Boston Gear Works.



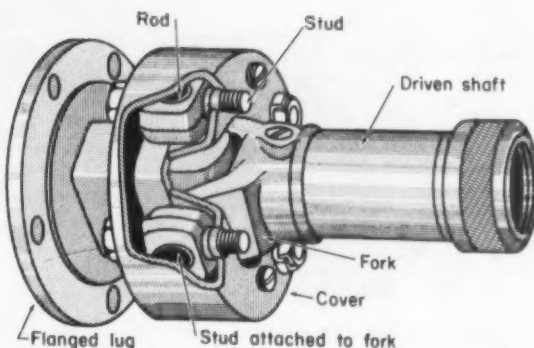
CLOSE COUPLED DOUBLE JOINT—Courtesy Lovejoy Flexible Coupling.



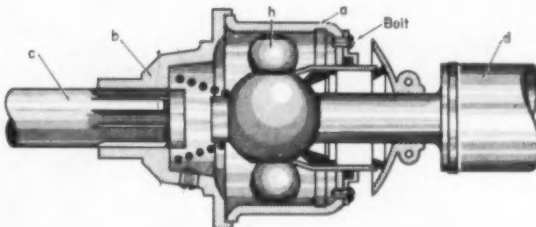
ELONGATED standard-duty double universal joint, useful for connecting shafts that would otherwise require careful alignment—Courtesy Lovejoy Flexible Coupling Co.



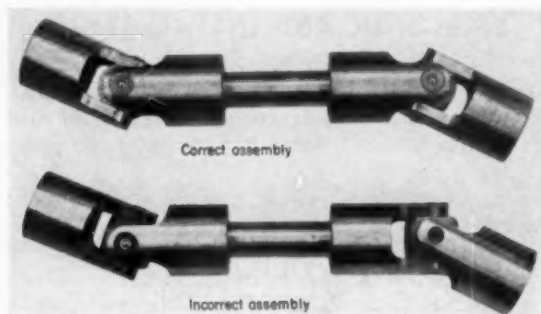
LARGER DOUBLE JOINT, useful for very heavy mobile equipment. It has caged needle bearings to make the heavy loads on the "cross", and the rollers tapered for better stress distributions. A tapered trunion shoulder is incorporated for better stress distribution, and it carries a double-lip dirt seal, that effectively prevents dirt infiltration to the splines—Courtesy Twin Disc Clutch Co.



DESIGNED FOR EASY MAINTENANCE, this type has no "cross" of any form. Instead, four threaded studs hold the shafts together through a cover. The cover, made of pressed steel, takes most of the stress imposed on the joint in service. Cork seals make the housing oil-tight—Courtesy Mechanics Universal Joint Co.



BALL UNIVERSAL JOINT uses 2 balls on a shaft. They swing forward and back, and roll side to side for universal motion. Balls are slightly smaller than the slot in which they run. Disassembly: Remove bolts, and slide "a" right. Pry end of spring from boss on guide "b" and pull the assembly away. Dust cover can then be removed to inspect balls—Courtesy Detroit Universal Joint Co.

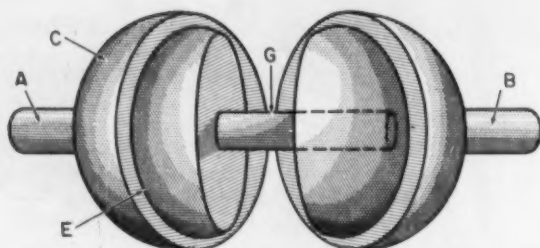


2. RIGHT AND WRONG ways to connect two universal joints. To transmit maximum power at a constant speed, the forks of the drive must be parallel to those of the driven joint.—Courtesy Boston Gear Works.

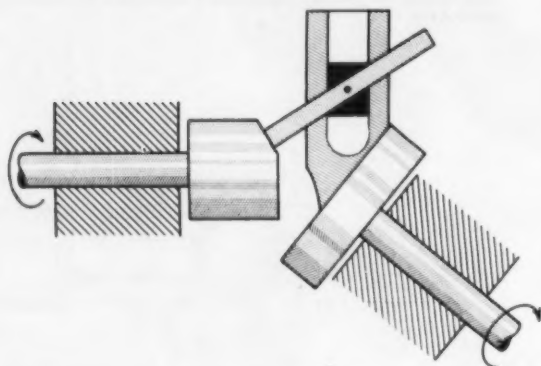
kept as small as possible. When two universal joints are to be used to connect parallel-but-offset shafts, they must be installed correctly in order to have uniform rotation of the driven shaft (Fig. 2). Incorrect installation can result in rotation fluctuation of up to 60 percent of the actual rotative rpm.

How much of an angle—The faster the shaft turns, the smaller the operating angle must be for minimum power loss. It is impossible to produce exact figures, but Table I may act as a guide.

Check the critical speed—This is another important factor in the design of universal joints and shafts. (see Torsional Vibration, p. 39). Select a length and size of shaft so that the critical speed of the

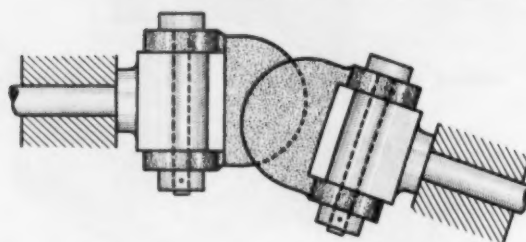


BALL AND SOCKET JOINT gives true constant velocity. The fork of the driving shaft sits in a slot on the spherical surface E, for slightly over half a circle. This prevents disengagements during operation. The block G is attached to E, and is exactly at the center of the joint. It slides within a groove on the driven side.

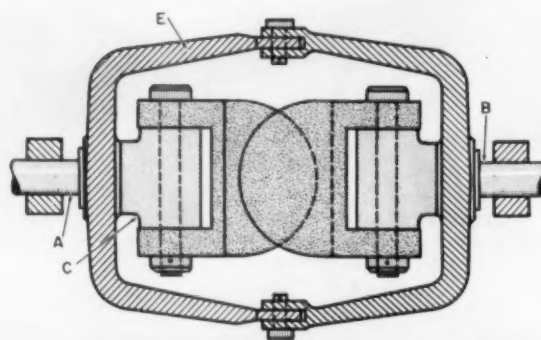


CONSTANT VELOCITY of the driven shaft is attained by a sort of harmonic cancellation. The point which transmits motion through the joint is always at a constant distance from the plane of the joint. Hence the motion is smooth and uniform (see text).

CONSTANT-VELOCITY



BARTLETT UNIVERSAL JOINT provides almost-constant velocity at reasonable cost, in a simple design.



TRUE CONSTANT-VELOCITY JOINT (of the Bartlett type) is more complicated. The two interlocking blocks marked C are provided with cylindrical extensions that pin together on the Y-axis. The arms so formed can swing in unison with the swivelling blocks.

critical speed is below the operating speed, then there will be resonance during normal operation. This condition can lead to abrupt failure. Obviously, altering the length or diameter of the shaft will change its stiffness and the critical speed of the system. Consider this when altering a standard joint system. In initial design, remember that greater stiffness can be achieved without extra weight by using hollow or tubular shafting. Further, note that the critical speed depends on the geometry and weight of the shafting, not on its materials' strength. The accepted formula for calculating the critical speed is

$$n_c = \frac{1852}{L^2} \frac{EI}{(W)}$$

Where n_c = critical speed rpm

E = modulus of elasticity of material of shaft

I = shaft's moment of inertia

W = weight, lb per in. length

L = unsupported length of shaft in in.

For solid shafts this formula is often used:

$$n_c = \frac{4,792,000}{L^2} \times D$$

Where D = shaft diameter-in.

Since the critical speed varies as $\left(\frac{I}{W}\right)$, the advantage of tubular shaft in increasing critical speeds is very obvious.

SELECTION AND INSTALLATION

Parallel alinement of driver and driven shaft is all that is required when universal joints are used. No thrust loads can be transmitted. Efficiency of pairs of universal joints is about 99.5 percent, at 6 deg. working angle.

Shaft size is determined by horsepower, rpm, class of duty and operating life. Use

$$hp = \frac{2\pi NT}{396,000}$$

where N = speed in rpm

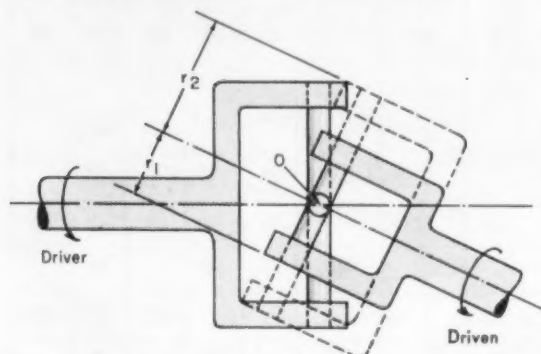
T = torque in in. lb

UNIVERSAL JOINTS

When a simple universal joint rotates, the speed of the driven shaft varies relative to that of the driver.

This can be clearly seen by considering the motion of the joint in the sketch below.

When the driver is turning at a uniform speed, the driven shaft's speed is determined by the speed of the cross in the driven plane. This speed is easily seen to be in direct relationship with the distance of the driven fork from the intersections of the shafts at O.



So, when the driven shaft is in the "solid" position its speed is a function of r_1 . When the driven shaft is in the "ghost" position, its speed is a function of r_2 . The distance "r" varies sinusoidally with each turn of the driving shaft, so that the speed of the driven shaft varies likewise.

Sometimes, the speed of a driven shaft must be controlled and/or uniform. If the driving shaft cannot be parallel with the driven shaft, the only solution is a constant velocity joint.

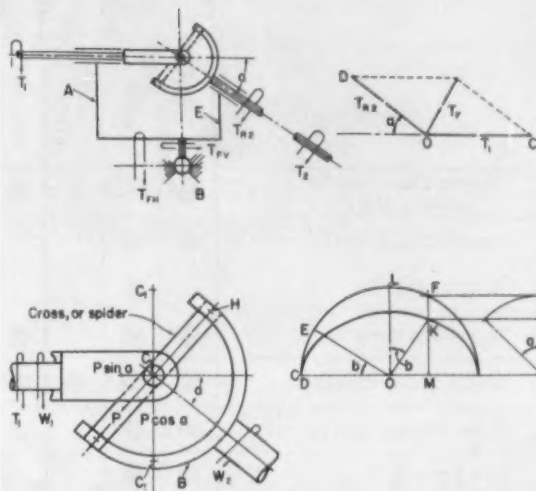
Length and type of shaft is determined from location of the machines. Standard sizes should be used whenever possible, because of the higher costs involved in ordering specials. Lower limits on distance between machines is the shaft-coupled double joint length. Centerline offset at this distance is determined from Table III. Hollow shafts offer advantages when power or weight is at a premium, as where high-speed stops and starts are necessary. Sometimes multiple double joints can be used instead of one special.

Dynamic balancing is usually unnecessary. Most manufacturers will balance joint systems when required.

Shaft angles—working angles are recommended in the table on p. 20. Clearance angle is the maximum momentary angle allowed, either when the joint is disconnected from the drive, or when one of the machines moves during operation. It is usually not greater than 45 deg.

Machinery alinement is not critical, except that driving and driven shafts be parallel within ± 1 deg.

FOR THE DESIGNER



TOP SKETCH is a universal joint carried in a frame A supported on a ball joint B. Parallelogram of forces right gives the torque T_2 acting on the frame.

LOWER SKETCH defines the angle b at any instant. Two curves in the diagram on the right show the instantaneous positions of the driving and driven forks.

Forces on a joint

The torques, forces and moments acting on the joint of the driven shaft for a constant driving shaft rotation can be very valuable in designing a universal joint.

They can be found in Theory of Machines textbooks, but are listed here for your convenience.

Rocking torque on input forks:

$$T_{R2} = T_1 \cdot \tan a \cdot \cos b$$

Rocking torque on output forks:

$$T_{R2} = T_1 \cdot \tan a \cdot \sin b \cdot \sqrt{(1 - \sin^2 b \cdot \sin^2 a)}$$

If the joint is supported in the frame A carried by the ball joint B, the forces transmitted to the fixed foundation through the frame shown are:

$$T_{FV} = T_1 \cdot \tan a \cdot (1 - \sin^2 b \cdot \sin^2 a)$$

$$T_{FH} = T_1 \cdot \sin^2 b \cdot \sin^2 a$$

Since T_1 always lies in the plane containing the shaft axes, the torque on the frame never contains a component perpendicular to that plane. Torque acting on portion A of the frame is always $T_{R1} \times$ Torque acting on the portion E $= T_{R2}$

Construction hints

- Keyways must always be at 90 deg. in double joints.
- Dimensions of square holes in hubs, and OD of splines must be less than distance between ears of forks.
- Drill, broach and cut clear through—do not use blind holes.
- Many manufacturers supply template drawings free on request.

BUYERS GUIDE TO UNIVERSAL JOINTS

COMPANY	DESIGN			SHAFT DIAM.			MAX RATED TORQUE, IN.-LB		MAX OPERATING ANGLE/JOINT	BEARING		MATERIAL	
	SINGLE	DOUBLE	CONSTANT VELOCITY	UNDER 1-IN.	1-IN. - 3-IN.	OVER 3-IN.	UP TO 100,000	OVER 100,000		ROLLING	SLEEVE	FERROUS	NON-FERROUS
American Stock Gear Div. Perfection Gear Co.	●			●	●		●					●	
Apex Machine & Tool Co.	●	●			●	●	●		35	●	●	●	●
Borgeson Mfg. Co.		●											
Boston Gear Works	●	●		●	●						●	●	
Con-Vel Div. — Dana Corp.	●	●	●	●	●	●		●	41	●		●	
Curtis Universal Joint Co.	●	●		●	●	●	●		37		●	●	●
Ford Motor Co.	●	●			●		●	●		●		●	
Gray & Prior Machine Co.	●	●		●	●						●	●	●
Koelling Universal Joints		●				●		●	10	●		●	
Lovejoy Flexible Couplings	●	●	●	●	●	●	●		40		●	●	●
Mechanics Universal Joint Div. Borg-Warner Corp.	●	●	●	●	●	●		●	35			●	
Neapco Products, Inc.	●				●				45	●	●	●	
Olson Industrial Products		●		●	●		●				●		●
PIC Design Corp.	●	●		●			●				●	●	
Precision Tool Mfg. Co.	●	●		●	●		●				●	●	
Precision Universal Joint		●			●	●					●	●	
Rockwell Standard Universal Joint Div.		●		●	●	●		●		●		●	
Twin Disc Clutch Co.	●	●				●		●	20	●		●	
Union Gear & Sprocket	●	●											
H. S. Watson Co. (Spicer)		●			●	●				●		●	

Concrete or steel beam is generally sufficient foundation. Note that parallel misalignment induces vibration, and the higher the misalignment, the greater the vibration. When parallel misalignment is unavoidable, use multiple shafts or constant velocity joints.

Life expectancy depends on the stresses and strains induced in the joint throughout its life. It is impossible to determine accurately, but for most specifications, over 8000 operating hours at 1750 rpm can be expected.

Where 8 hr per day operation is sustained at rated torque and rpm, up to 10,000 hours is not unduly high. Very often "life expectancy" is fixed by bearings—their replacement at failure can provide another

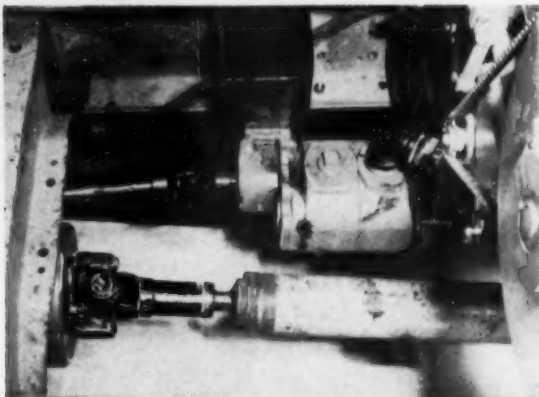
life for the joint. Most manufacturers will supply data.

Lubrication is vital—Especially with a new joint, lubrication can determine the life of a joint. Normally, open joints require grease, totally enclosed joints more often use oil.

Relubrication is necessary about every 100,000 revolutions for open universal joints. As a guide, a 5-in. diameter joint will require 3 ounces of grease, and an 8-in. diameter joints, about 10 ounces. Many types are sealed, require little or no lubrication.

Requests for reprints of this article should be addressed to: Reprints, POWER TRANSMISSION DESIGN, 812 Huron, Cleveland 15, Ohio. Prices: single copies—free; 2-10 copies—25c each; over 10—15c each

Driving a pump



The Holan Corp., Cleveland supplies hydraulically operated derricks, diggers and winches mounted on their customers' trucks. They quickly found the best system used a split-shaft power take-off from the main drive shaft. Power taken off turned the double universal joint that drives the hydraulic pump. Hydraulic motors are used to position the derrick, and so on.

Full engine torque is transmitted through the PTO universal, which is a 1¼-in. dia. solid shaft, Spicer No. 1350 series. It carries 2160-in. lb of torque at 1800 rpm, operates intermittently up to 8-hr periods.

The hydraulic pump supplies 45-gal per min at 2000-psi; returns the oil to a low pressure reservoir. Lubrication is the same as that used for the truck chassis, and universal joint.

The double universal joint does not have to be splined because both PTO and hydraulic pump are bolted rigidly to the truck chassis.

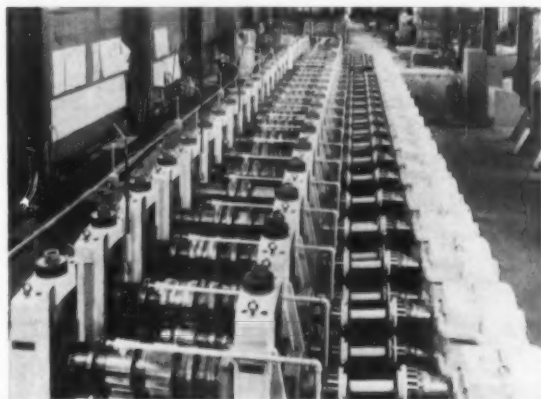
The smaller universal joint is a Spicer 1350 series, drives the hydraulic pump. The larger joint is a

Spicer 1550 series M; it has a hollow splined shaft, transmits up to 200 hp at 3500 rpm. It is in the truck's main drive shaft.

For continual misalignment

Typical heavy industrial application of universal joints in a rolling mill. Power is transmitted efficiently from the independent drive motors to each pair of rolls. When the rolls are forced apart by the metal strip squeezing between them, these slider-type joints accommodate the change in angularity, continue to transmit hundreds of horsepower at over 99 percent efficiency.

As a bonus for the mill operator, the drives were installed without expensive foundation alinement. Thousands of dollars were saved because the drives didn't have to be level with the mill rolls.



Con Vel Div.-Dana Corp

Automobile driveline

In line with the present trends, Ford Motor Company engineers had to lower the drive line in their new automobile design.

Design assumptions called for conventional location for the power train, with larger angles at the driveshaft joints. An angle of over 8 deg. was called for at the front.

This high angularity prevented use of a simple joint, because of high induced vibrations. The engineers decided to use a constant velocity joint. This, they felt, practically eliminated the torsional vibration generated in the front steering assembly. The rear joint was kept within 2½ deg.

When the time came to select the constant velocity joint, various designs were considered. Bendix-Weiss, Tracta and Rappa were rejected, because previous ex-

perience showed them to be most suitable for low-speed applications. The double-Cardan design was selected, but the centering device had to be re-designed. Problems to be solved were:

- To provide adequate lubrication, especially under high-speed driving conditions.
- To limit wear on the sliding centering device, to insure sufficient life for an automobile.
- To determine manufacturing tolerances suitable for the job in hand.

The final design was determined by laboratory testing. The lubrication cycle was fixed at 6,000 miles, wear was suitably limited, and satisfactory manufacturing tolerances were set up.

Case history taken from SAE paper 320-D "Engineering the Continental Driveline." by D. R. Veazy.

Many motors replace one !

Using a low-frequency converter, a steel mill replaced a single motor, gears and couplings, with a whole line of direct-drive rollers. Result? 50% savings.



A STEEL-MILL ROLLER TABLE utilizes a series of squirrel-cage induction motors to turn the rolls. Each motor turns one roll. There is no reduction gearing between the motor and roll. To get required low speeds, a low-frequency converter reduces the incoming 60-cps current to 1.3 to 5.2 cps. This gives roll speeds of 19 to 78 rpm. Careful selection of motor and frequency may give roll speeds as low as 10 rpm.

The low-frequency motor drive has these advantages over dc or multiple-ac motors, foot or flange mounted units, or gearmotors:

1. Greater mechanical and electrical reliability.
2. Less maintenance.
3. No special couplings or bedplates.
4. More compact.
5. Higher electrical efficiency.
6. Withstands prolonged stalling without damage.

Direct drives can do some jobs better and cheaper. Conventional drives with foot-mounted or flange-mounted motors must transmit power through couplings or gearing. This exposes them to the mechanical shock and distortion which so often leads to abnormal wear and mechanical failure of bearings, couplings, and gears. Electrical failure may also result.

In addition, the thermal shock loads that occur when the rolls handle hot materials may have the same adverse effects on gearing, bearings, and couplings. Low-frequency induction motors minimize these effects because they have high capacity to absorb the shocks and distortions.

Squirrel-cage motor—The motor rotor has a steel sleeve. It mounts on the roller shaft extension to make the rotor an integral part of the roller assembly. A

special tie-bar prevents rotation of the motor frame. There can be no slip between roller and motor because the two are directly connected.

The motor operates from a variable-frequency supply. It has characteristics similar to those of dc motors operating from a variable-voltage supply. Typical speed-torque and speed-current curves are shown (right).

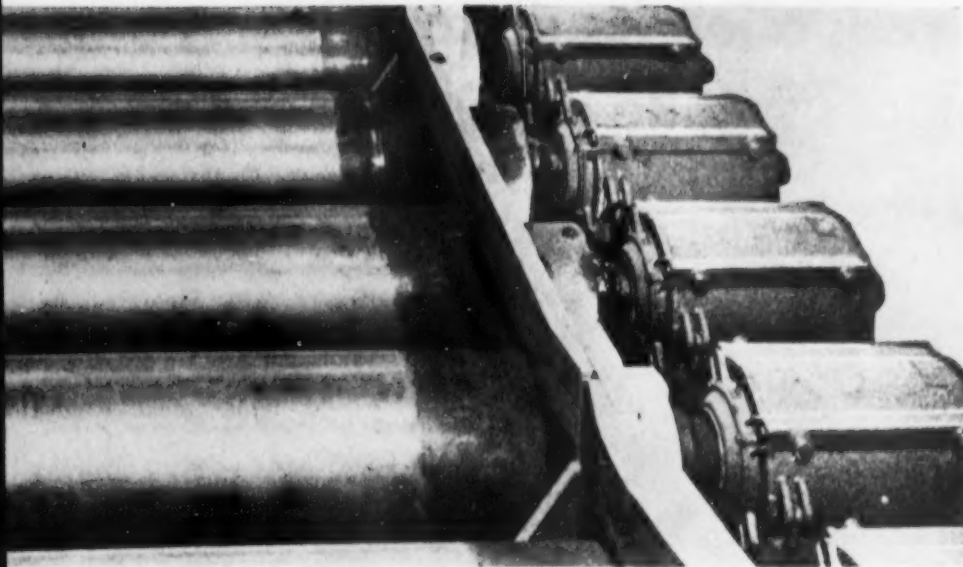
Increasing the frequency accelerates the motors to required speed. Reducing the frequency brakes the motors.

Starting the motors at lowest frequency keeps starting currents, and hence heat losses, low. The motor design also includes a high power-factor characteristic that keeps the induction losses down, while producing high starting torque. This permits the motors to be stalled at full voltage for long periods.

An induction motor connected directly to a 60-cps supply performs poorly because of high magnetizing currents and reactances. This results in very low motor efficiency and power factor. The motor would operate poorly in stalled, plugging, or reversing duty. It would be plagued with high temperature rises and frequent failures. A separate low-frequency supply eliminates these disadvantages.

Frequency converter—Consists of a rotor with sliprings at one end and a commutator at the other. The 3-phase, 60-cps electric supply feeds the sliprings. Controlling the mechanical speed of rotation of the rotor in the magnetic field gives the desired low frequency. Overcoming the friction and windage losses is the only power required to drive the converter rotor. This permits the use of a comparatively small driving motor. For example, a 70-KVA, 6-cps converter requires only a 15-hp driving motor.

An induction regulator permits the output frequency

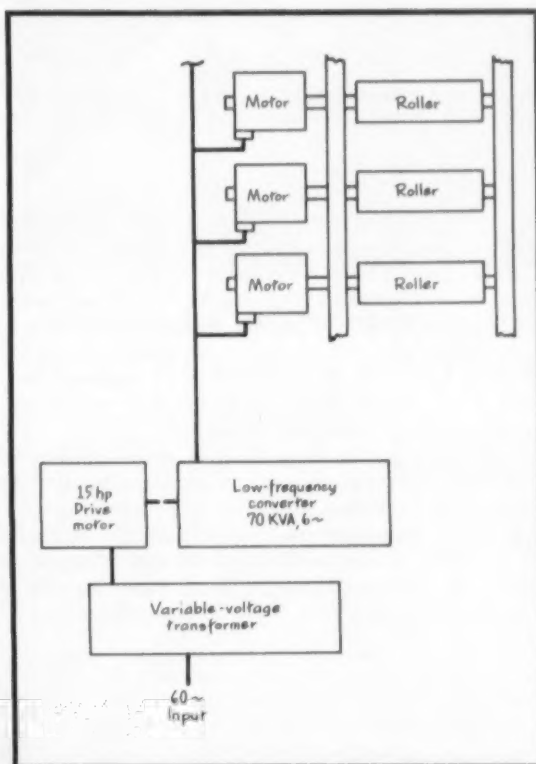
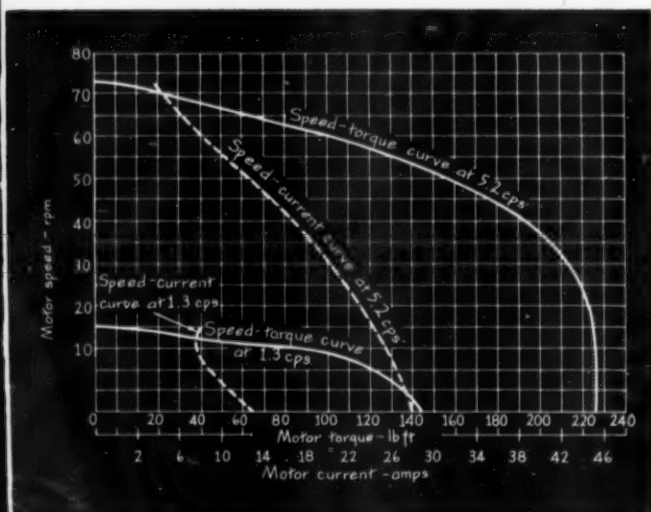


ROLLER-TABLE DRIVE
system uses a low-frequency converter to control squirrel-cage induction motors. Each induction motor drives one roll.

and voltage of the converter to vary simultaneously. This controls the speed of the roller-table motors.

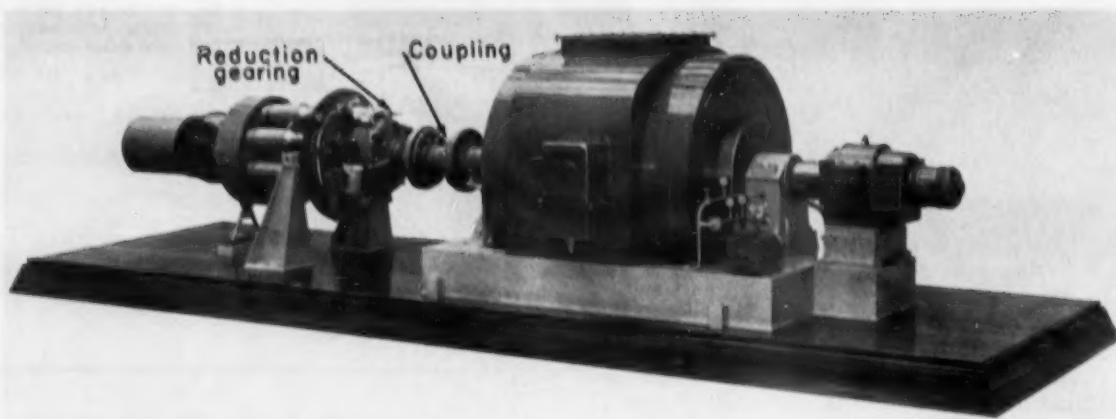
Low-frequency motors come with speeds as low as 10 rpm. They have infinitely variable or stepped-speed ranges. Another feature is automatic operation that gives a voltage proportional to frequency. This permits efficient operation of the low-speed motors for the entire speed range. Increase in efficiency of this system over conventional systems results from lack of transmission losses.

Technical assistance for this article supplied by W. S. Guttenberg, Vice President, Bogue Electric Mfg. Co., Paterson, N. J. ♦



SPEED-TORQUE and speed-current curves. Motors have high power factor at starting. Inrush current produces high torque with minimum heat loss. Efficiency of the individual motor drive system is as much as 50 percent greater than that of conventional gear driven systems. This increase is directly attributed to savings from mechanical transmission power losses.

Speed reduction leads to economical mobile generator



A 3-MW TURBO-GENERATING SET that is in service in two unmanned, entirely self-contained, remote-controlled power sta-

tions in England. The prime mover is made by Bristol Siddeley Ltd., adapted from their Proteus aircraft engine.

LACK OF A SUITABLE PRIME MOVER has been retarding the design of efficient auxiliary-power generating plants. The lean days may be over. A packaged power plant powered by a gas turbine aircraft engine is now available. Its use has been made possible by the design of a suitable high ratio speed reducer.

The turbo-generator pack can be mounted on a truck or railroad flatcar and placed in service anywhere without unloading or jacking.

The pack will handle peak loads, serve as industrial, emergency, or maintenance standby, and be ideal for remote and disaster areas.

● **Drive components**—Power from the turbine is transmitted to the output shaft through a compound epicyclic planetary reduction gear. Ratio depends on requirements of 6.25 to 1 for 60 cycle operation.

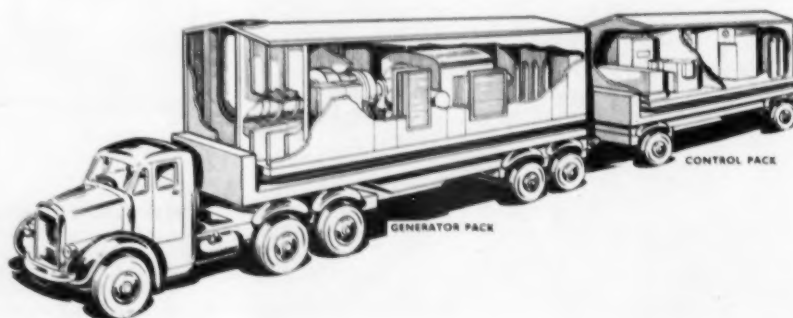
An engine firewall is included in the bulkhead to make an airtight seal between pack compartments. The reduction gear and drive shaft extend through this bulkhead. A coupling (covered by a steel-mesh guard) connects the engine to the generator.

Where outside air does not exceed 70 F, the turbo-prop engine runs at top compressor speed and develops power at normal rating. The highest power is available in cold weather when it is needed most. Winter months have the highest peak loads.

Where outside air reaches 85 F to 100 F, the makers must derate the engine to prevent it from overheating.

Allowance must be made for operation at atmospheric pressures other than 14.7 lb/sq. in., however, specific fuel consumption is independent of atmospheric pressure.

FUTURE USES of the transportable power generator include remote area servicing. The truck transporter shown is 34 ft long by 9 ft wide. The control equipment (on second trailer) is required only where suitable control equipment is not already at the site.

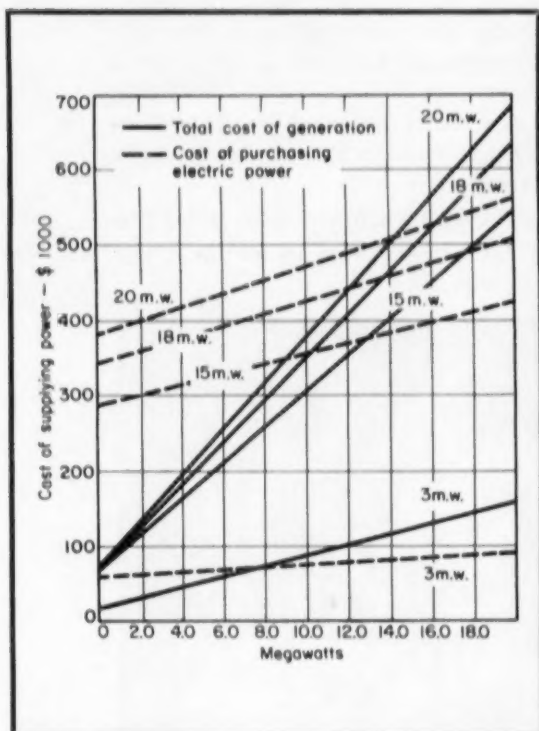


• **Engine particulars**—The turbine is an adaptation of the Bristol Siddeley "Proteus" turboprop engine. It is a free-turbine, that is, the compressor and power turbine systems are mechanically independent of each other. This allows both to operate at their best efficiencies.

The engine's four turbine stages are coupled in pairs. The first pair drives the compressor, the second, the reduction gear and output shaft. They are in a common housing supported to preserve concentricity while allowing for thermal expansion.

Engine speed is 11,250 rpm with output reduced to 1,500 or 1,800 rpm depending on requirements, through a massive gear reduction system.

Two tanks, each containing 7500 Imp. gal. (1 Imp. gal. is equivalent to 1¼ U.S. gal.) of diesel fuel, provides at least 50 hours running at full load. Consump-



COSTS SHOWN by these curves include capital repayment, engine maintenance, fuel, oil, and general maintenance costs. They show that the mobile generator produces power more cheaply below 15 MW than the electric companies. Thus, when a load peak occurs in some area, the mobile unit can supply it more cheaply than starting up a larger stationary generator. However, if a stationary generator is operating at, say, half load, the peak power can be supplied more economically by increasing its output.

tion at full load is 2,360 lb./hr. Lubricating oil is used at ½ Imp. pt./hr.

• **No engine overloading**—Operating with no human supervision, the engine will run under governor control at the load demanded to maximum capacities.

Continued on page 48



flexible gear coupling you can buy!

Now you can transmit power in a wide range of speeds and capacities with the 14 ounce Nyflex® "Mite" nylon sleeve coupling. Use it in both the vertical and standard positions at speeds to 5000 rpm without lubrication. The "Mite" absorbs up to ±3° misalignment at these speeds yet the whole coupling is less than 3" in diameter.

The "Mite" is available now in ¾" rough bore and 8 finish bore sizes from .500" to 1.125" through over 150 industrial distributors. Use the inquiry card or write direct to Sier-Bath for the name of your nearest distributor and complete performance and specification information on the "Mite".



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It pays to buy from a line of stock bearings—bearings that have been proved in thousands of installations similar to yours. You benefit by getting known dependability; and you get the important savings of high quality at production price.

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Dodge has supplied mounted bearings to industry for over three-quarters of a century. Dodge bearings have always kept pace with improved production practices. Each new condition of service has been met by Dodge as it has arisen, with the result that the Dodge line contains mounted bearings to meet almost every service requirement with pin-point accuracy.

High load, high speed, excessive dust, moisture, corrosion, high or low temperatures, continuous operation—you name it!—such conditions and their combinations are met every day with Dodge bearings.

BROAD LINE—WIDELY DISTRIBUTED

In the great variety of mounted bearings developed by Dodge, you will most likely find the precise unit to fit your requirements ideally—without paying for features you do not need. And if your requirements call for several types of bearings, there is an advantage in having them of common design, such as Dodge offers.

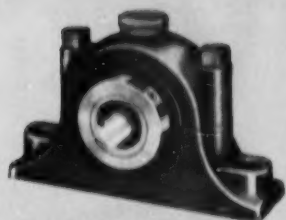
The Dodge line is probably broader than any other line of mounted bearings in America. And of special importance to machinery manufacturers, it is the most widely distributed line. There is always a Dodge bearing of the right type and size near at hand.

You can check this with your local Dodge Distributor. Ask him—or write us for the Dodge Bearing Bulletin.

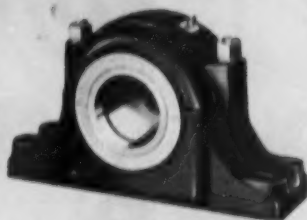


In addition to tapered roller, spherical roller and ball bearings, Dodge builds many types of sleeve bearings. Here is the "large and small" of the sleeve type bearings carried in stock—ranging from an 8-in. Sleeveoil weighing over 1200 lbs. to a 1/2-in. solid journal bearing weighing 9 ounces.

DODGE MANUFACTURING CORPORATION, 8200 Union Street, Mishawaka, Indiana



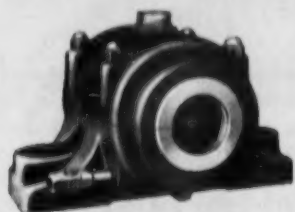
**DODGE PILLOW BLOCKS WITH
TIMKEN TAPERED ROLLER BEARINGS**



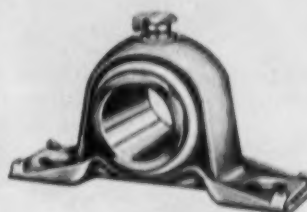
**DODGE SPHER-ALIGN PILLOW BLOCKS
WITH SPHERICAL ROLLER BEARINGS**



**DODGE BALL BEARING
PILLOW BLOCKS**



**DODGE SLEEVOIL
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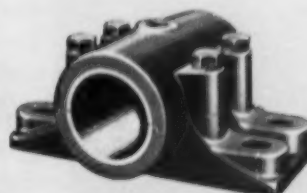
**DODGE BRONZOIL
PILLOW BLOCKS**



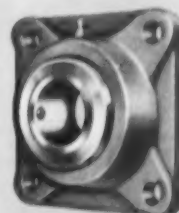
**DODGE BRONZE BUSHED
PILLOW BLOCKS**



**DODGE JOURNAL BEARINGS
SOLID AND SPLIT**



**DODGE HEAVY RIGID
PILLOW BLOCKS**



**FLANGE BEARINGS; HANGER
BEARINGS; BEARING UNITS;
TAKE-UPS**

● **Dodge Pillow Blocks with Timken Tapered Roller Bearings.** America's quality pillow blocks. Assembled, lubricated, adjusted and sealed at the factory. 5 types for varying needs.

● **Dodge Spher-Align with Spherical Roller Bearings.** Rugged heavy duty, compact, inherently self-aligning. Exclusive Micro-Mount simplifies installation.

● **Dodge Ball Bearing Pillow Blocks.** Deep groove ball bearings with long inner races—high capacity. SL, SC and SCM models for light, normal and medium service respectively.

● **Dodge Sleeveoil Pillow Blocks.** Ultra quality . . . extra long life . . . accessibility . . . quiet. Plain or water-cooled.

● **Dodge Bronzoil Pillow Blocks.** Efficient, low cost pillow blocks with self-oiling, capillary bronze bushings. Self-aligning. Large oil reservoirs.

● **Dodge Bronze Bushed Pillow Blocks.** Quiet fan and blower pillow blocks with two bronze bushings of high lead content mounted in one cast iron housing.

● **Dodge Journal Bearings—Solid and Split.** True running, dependable. Babbitted bearings with precision machined bores and faces. Finished bases.

● **Dodge Heavy Rigid Pillow Blocks.** Rugged, carefully bored, babbitted pillow blocks for many applications requiring grease lubrication. Finished bases and ends.

● **Bearing Units.** A wide variety—spherical seat, cartridge, flange, hanger, screw conveyor hanger, take-up. Ball, Roller and Sleeve types.

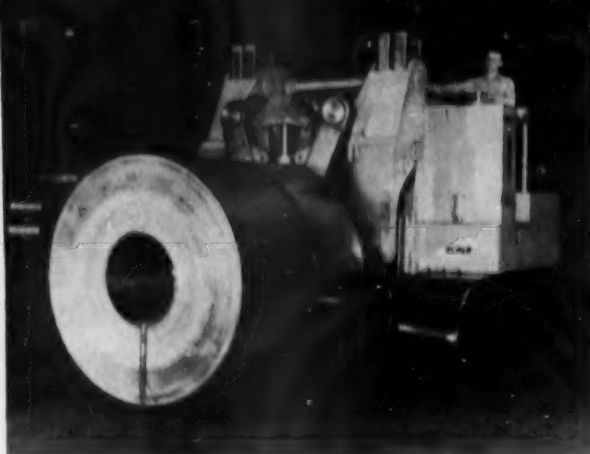


CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look under "Dodge Transmissioneer" in the white pages of your telephone directory, or in the yellow pages under "Power Transmission Machinery."

DODGE

→ of Mishawaka, Ind.

Second shaft simplifies steering

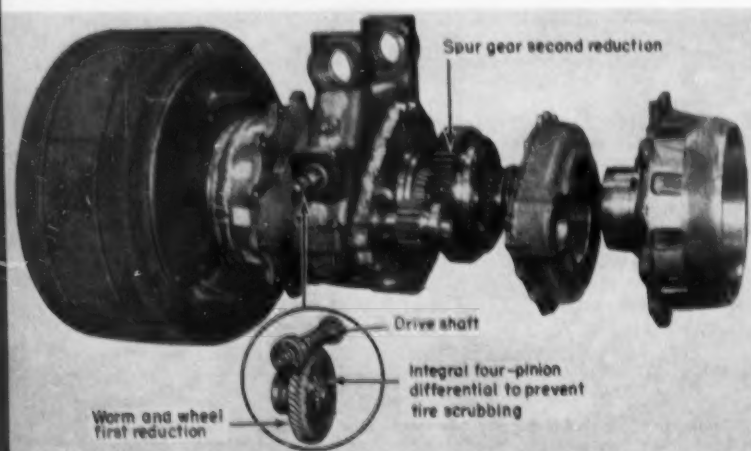


TWO DRIVESHAFTS each drive a separate pair of front wheels at the correct speed to prevent tire scrub on turns, in an electric ram truck.

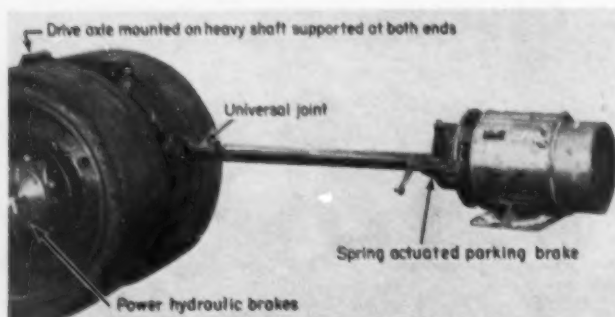
Each driveshaft is powered by an electric motor whose speed is controlled by an electric field motor controller. This the slower-turning motor is slowed less,

on turns, and vice versa. This has the same effect as a mechanical differential. A control is included, so that, even if one pair of wheels completely loses traction, the other will take the full load.

The double drive system has other advantages, too. When one pair of front wheels is higher than the other (when the truck operated on very rough ground), full pulling power is still available from each pair. Incidentally, these trucks can operate on rough ground with far less danger of breaking an axle, since the axles are never, cantilevered, never carry the full weight of the load on one wheel.



THIS EXPLODED VIEW of the drive axle was made by photographing the components as they stood supported on a bench. The truck has a capacity 200,000 lb.—and the axle is suitably chunky.



ONE OF THE TWO DRIVES. The mechanical emergency brake also engages when the operator leaves the truck. The drive motors are built and designed by the Elwell Parker Co.

A hint to electric car builders—using the double shaft enables the manufacturer, Elwell-Parker Co., Cleveland, to mount the driveshafts well inside the frame. This protects them from damage, and yet eliminates the "driveshaft tunnel" that has been annoying car-makers for generations.

When the front axles need maintenance—they can be taken out without touching the drive motors. The double driveshafts are splined at the axle end.

Unusual speed reduction unit—Because the truck is driven by an electric motor, no gearbox is required, in the normal sense. However, the axles only turn at about 60 rpm, and the drive motor runs at 1200 rpm. The reduction is made through, first a worm reducer, and then a differential, and then a spur gear reduction unit. The differential also cuts out that small amount of tire scrub that would take place between the two wheels on the same axles, were they rigidly connected. Each wheel has its own spur gear reduction.

Even braking is simplified by using two drives. When slight braking is required for turns, the electric motors are dynamically braked. For stopping, during normal operation, hydraulic brakes are provided on every wheel. And for emergency use, a mechanical brake locks the motor armatures. ♦

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easier mounting,
greater
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Electric Clutch



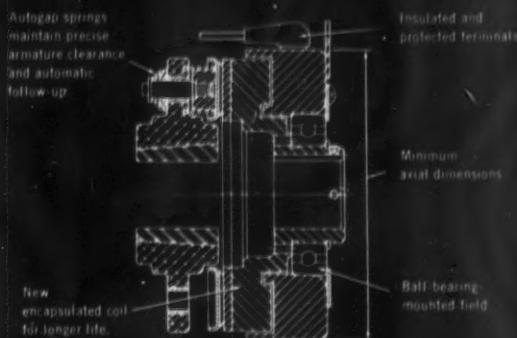
New Warner SF 500 clutch
Static torque rating—50 lb-ft

This new rugged and reliable Warner SF 500 electric clutch combines minimum size with maximum torque—up to 50 lb-ft static. It offers simplified mounting (no collector rings or brushholder) of the ball-bearing-mounted stationary field.

The new encapsulated coil delivers peak reliability, longer life under the severest operating conditions. Minimum axial dimension permits installation of the new SF 500 in smaller space than ever before possible—yet it replaces existing units without reworking or machining.

Improve *your* machine control economically, simply—with the new Warner SF 500 stationary-field clutch. It eliminates complex hydraulic, air, or mechanical linkages—gives you the simplest, most reliable control on the market today. Warner stationary-field electric clutches are now available in torque ratings from 1.5 lb-in. to 1350 lb-ft. Write today for full details.

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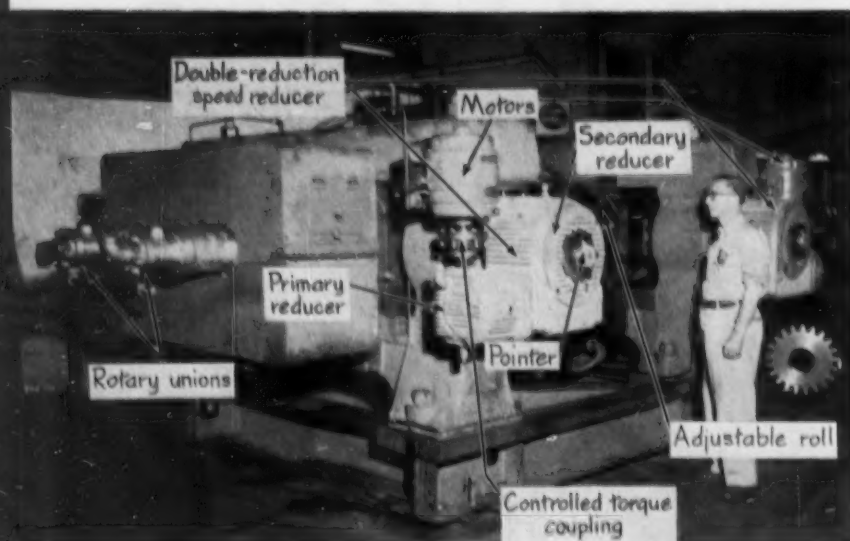
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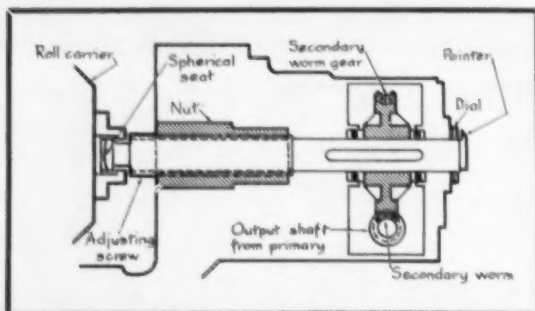
MILL FOR COMPOUNDING PLASTICS uses double-reduction speed reducers to position an adjustable roll. Rotary unions admit steam for heating into the rolls. Courtesy W. R. Thropp & Sons, Div. of J. M. Lehman Co., Inc., Lyndhurst, N. J., and Cone-Drive Gears, Div. Michigan Tool Co., Detroit.

Reducer controls compounding mill

Double reduction gives high reduction ratio.

Adjusting screw permits precise adjustment of roll.

SPEED REDUCERS in an unusual application control the thickness of plastic sheet with great uniformity. The reducers transmit power from electric motors to the adjustable roll of a compounding mill. Engineers selected double-enveloping worm-gear speed reducers because they can carry high loads and are compact.



WORM OF THE SECONDARY REDUCER couples to the extension of the primary output shaft. The secondary output shaft extends in both directions and slides within the worm gear. A roll-carrier adjusting screw is cut in one end of the extended shaft.

One set of reducers is mounted at each end of the (front) adjustable roll. This reducer set has adjusting screws which accurately position the adjustable roll with respect to the (rear) fixed roll. Synchronizing the roll adjustments makes the finished plastic sheet uniform. The synchronizing is electronic. Pointers on the reducer output shafts show the positions of both ends of the adjustable roll.

Each roll has a 28-in. OD and is 60-in. long. It exerts 3300 ppi of length, or about 100 tons total.

A standard reducer transmits power to the fixed roll. This roll turns at 4 to 16 rpm. The front roll is driven through 1: 1.33 ratio reduction gear from the back roll. Linear speed of rolled material varies from 30 to 115 fpm as it passes through the roll nip.

Each double-enveloping worm-gear unit has two speed reducers. It gives a total reduction of 4200 to 1. It reduces the output speed of the motor to 0.139 rpm at full-load low speed. At full-load high speed, output speed is 0.417 rpm.

Roll-carrier adjusting screws are cut into the output shaft extension of the secondary reducer. These screws have 4 threads to the inch, so the linear adjusting speed of the carriers is 0.035 to 0.104 ipm.

The secondary worm gear has a fixed key which permits the output shaft to slide through the gear for adjustments.

There are 44 divisions on the pointer dial. Each division represents 0.0057-in. of carrier travel. The time it takes for the pointer to move one division is a measure of the setting accuracy. At high speed, time is 3.3 sec. At low speed, time is 9.8 sec.

Speed-reducer manufactured by Cone-Drive Gears, Div. of Michigan Tool Co., Detroit. ♦

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PERFORMANCE

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REDUCE
DOWN
TIME

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Available in capacities up to 500,000 torque inch pounds, they are adaptable to a variety of applications—rolling mills, oil field equipment, irrigation pumps, cargo carriers, marine drives, logging winches, mining machinery and many others.

Blood Brothers Industrial Drive Lines offer these special features:

- Wing bushings that eliminate costly flange yokes and reduce down time during servicing. Simply remove 8 bolts for complete disassembly
- Sliding spline provides for quick, easy assembly—variations in mounting locations—longitudinal shaft movements during operation—deflections and temperature changes
- Easy access to lubrication fittings.

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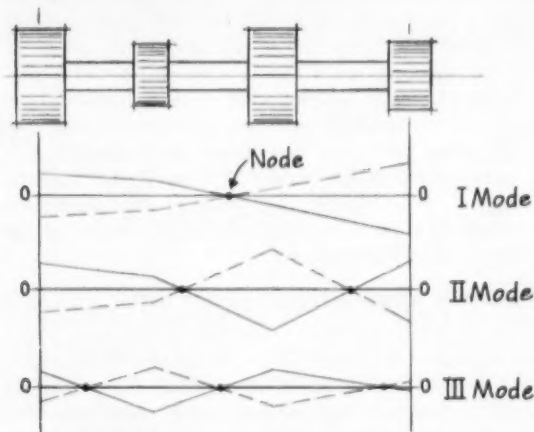
2000-A

TORSIONAL VIBRATION

By T. W. SPAETGENS, Consulting Vibration Engineer, Toronto, Canada

PART II—Multi-Mass Systems

SUBJECT A POWER TRANSMISSION SYSTEM to torsional vibration, and it often vibrates with several frequencies simultaneously. Whereas a 2-mass system considered in part I (PTD Sept.) has but one natural torsional frequency, a 3-mass system has two, a 4-mass system three, and so on. Sketch shows the vibratory shapes for the three modes of vibration of a 4-mass system. Each natural frequency has its node(s) at different locations in the system. Such a multi-mass system often vibrates in several modes simultaneously. Dynamic response for each



4-MASS SYSTEM has 3 modes (natural frequencies). Each has its nodes at different points, which complicate design problems.

mode depends on the particular relation between forcing frequency and natural frequency. At any one speed, one mode will predominate; at another speed another mode will predominate.

A CASE HISTORY . . .

The hydroplane represented broke almost 2 dozen shafts in one racing season. Average shaft life was around 2 hr. This shows the large number of critical speeds occurring in reciprocating engine multi-mass

systems. When the engines were applied to aircraft they had quite different torsional characteristics. The high damping effects of the aircraft system prevented quill shaft fatalities.

But hydroplane applications represent one of the most severe torsional vibration conditions ever analyzed. It is an excellent example of the damaging effects of torsional vibration in power transmission systems. Torsional effects in these craft largely cause broken connecting rods, bearing and crankshaft failures, gear box collapses, and other over-stress conditions.

Sources of Torsional Excitation

When there is uneven or variable torque in a torsional system, the torque harmonics cause torsional excitation. For the 4-cycle engine, $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 12, or even higher order harmonics



HYDROPLANES are subject to severe torsional vibration as well as other forms of mechanical battering. They are lightweight, with planing hull form and large engines.

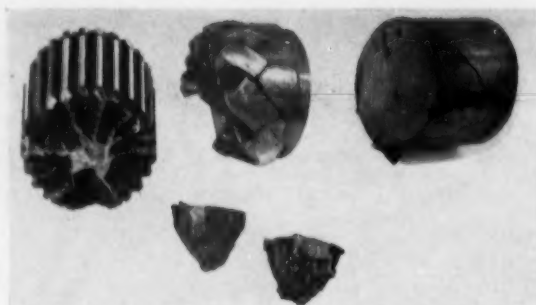
can be important. In any one engine, however, only a few harmonics would be of concern. Harmonic severity can be affected by crankshaft throw arrangement, V-angle, firing order, vibratory shape, and others. In 2-cycle engines there are no half-order effects. At low speeds, reciprocating engines (particularly 2-cycle) may excite strongly at 1st, 2nd, and 3rd order frequencies because of unbalanced firing characteristics.

Propellers and impellers can generate torque excitation. In marine propulsion systems, propeller-excited criticals can cause breakdown. Excitation factors up to 22 percent of mean torque have been recorded.

Torque components that occur at tooth engagement frequency, and variable torque components that result from errors in gear generating tools excite geared systems. Worn tools can introduce harmonic errors in teeth spacing and profiles. Universal joints may also produce significant 2nd-order disturbances.

Endurance of components

The blower shaft of the hydroplane power plant is a good example of how torsional vibration affects



STRIKING FAILURE of a hydroplane blower shaft. Notice the fatigue-like fracture of the end of the shaft, and the helical failure line on the surface.

machine components. The critical region in this case was the steel at the surface of the shaft. Its strength is 235,000 psi ultimate tensile, 180,000 psi ultimate shear, 60,000 psi torsional endurance limit. The steady stress includes acceleration and load stresses of 20,000 psi. Fatigue stress concentration factor for the shoulder fillets and spline area is about 2. Thus the effective stress variation for critical A, (left) is $2 \times 58,000 = 116,000$. Obviously the quill shaft life will be very short. The fatigue safety factor is $60,000/116,000 = 0.52$. Assume the failure curve is a straight line joining the ultimate shear strength and the shear endurance limit. Add the effect of steady stress and the safety factor is 0.49.

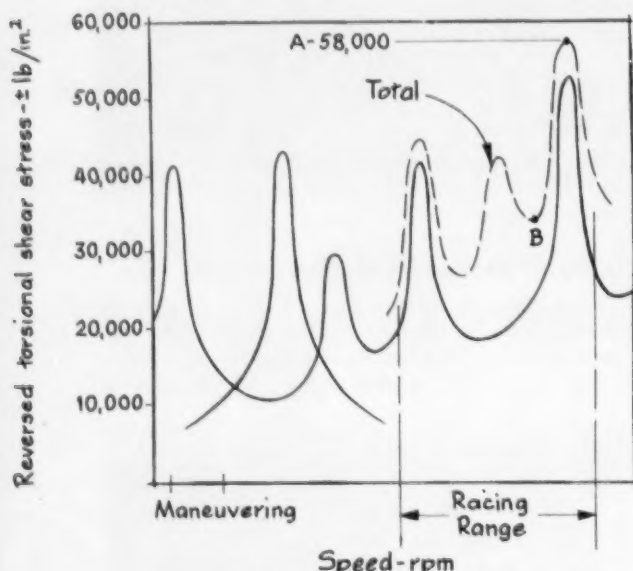
A theoretical endurance curve for the surface condition is obtained by joining shear endurance limit at 1 million cycles with a point at $0.9 \times$ ultimate shear strength at zero cycles, all on a logarithmic base (lower left). A life of 35,000 cycles has an effective variable stress of $\pm 116,000$ psi. Frequency of vibration at point A on the shaft happens to be 11,600 cpm. Quill shaft life is therefore $35,000/11,600 = 3.0$ min when running constantly at this rpm. In racing, speeds vary widely, with corresponding variations in stresses. Thus the life may actually substantially exceed 3 min if the material is equal to or better than that of the shaft considered. For instance, for constant operation at the point B, shaft life is 56 min.

Factors that affect shaft life

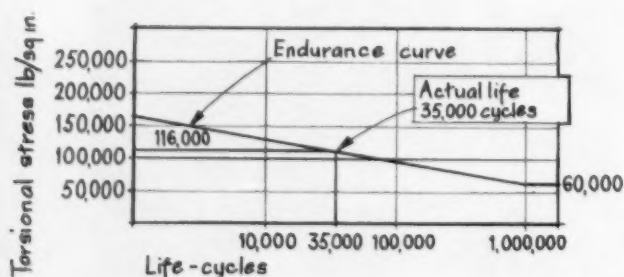
Quill shafts in other hydroplanes will have somewhat similar torsional vibration stresses. The critical points will vary from boat to boat, depending on gear box design, supercharger speed ratio, shafting and propeller characteristics, etc. Some shafts lasted between $\frac{1}{2}$ and 6 hr; undoubtedly physical properties of the shafts also had some effect.

Without excessive torsional vibration the theoretical quill shaft life would be almost infinite. In this example torsional vibration reduced component life to much less than 1 percent. It is interesting to note that in boats whose speeds are restricted to avoid the critical ranges as much as possible, quill shafts sometimes last over 50 hr. However, some fatigue damage is inevitable as the components must pass through the critical zones during maneuvering. These resonant stresses sometimes plastically deform the

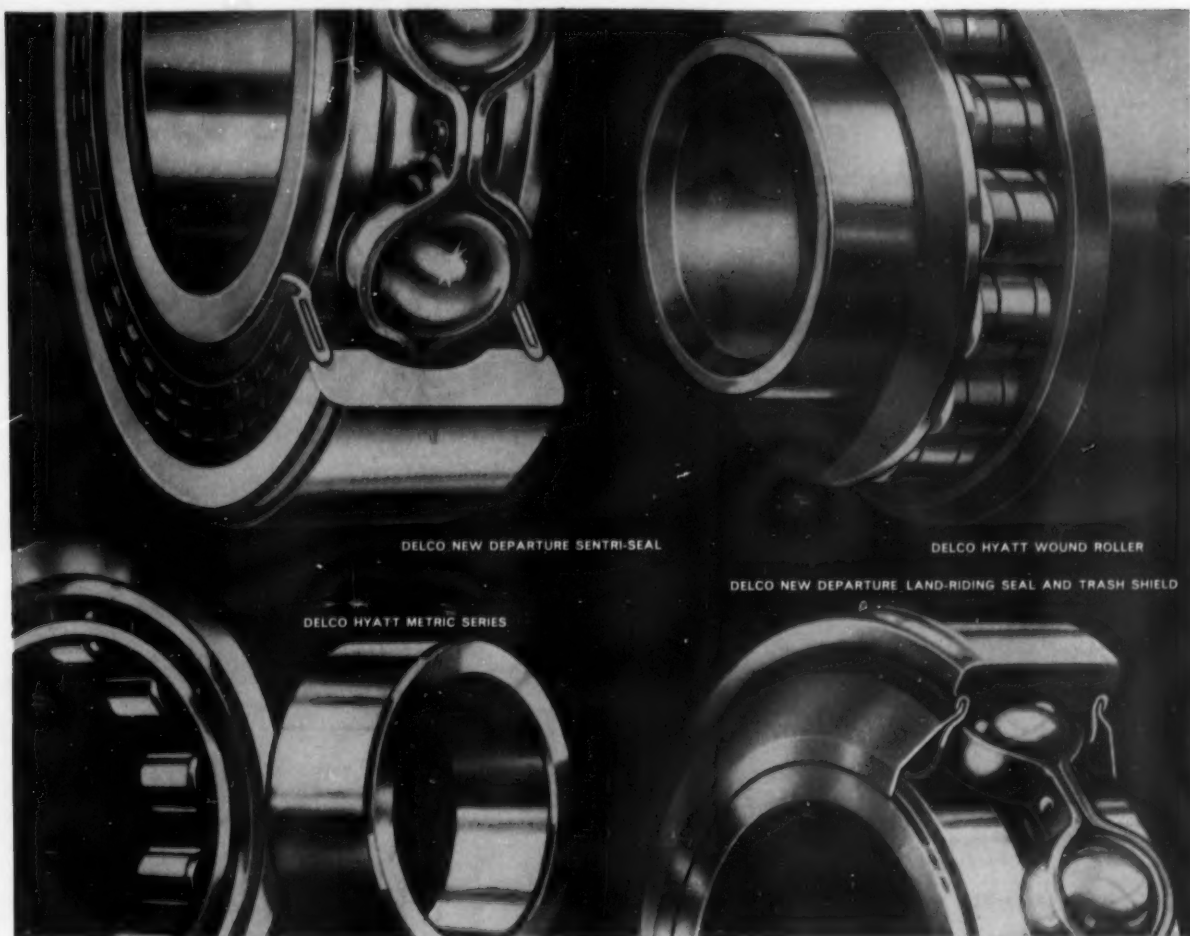
Continued on page 48



VIBRATION AMPLITUDES in a blower shaft. Dashed line (total) is correct as shown. The sum of amplitudes is not necessarily the arithmetic sum.



THE ENDURANCE CURVE shows the actual life of a case studied by the author.



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DELCO HYATT WOUND ROLLER

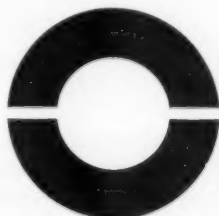
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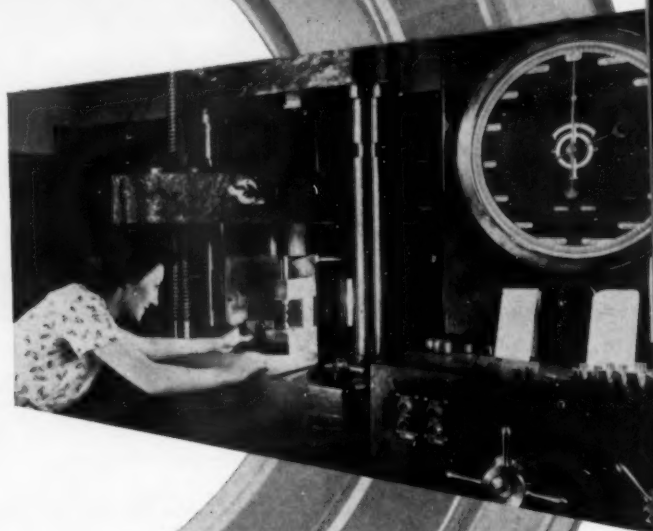


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BEARING SECTION

HAROLD BELANGER
bearings editor

Bearing Business

National Lubricating Grease Institute—has sponsored a new research fellowship on non-Newtonian flow in bearings, beginning Sept. 1961 at the chemical engineering department of Northwestern University, Ill.

For the first year the study will be limited to an infinitely long journal bearing filled with a grease described by the Sisko model. Results will show the effect of grease properties and eccentricity on velocity distribution, pressure distribution, load carrying and friction. This data should improve bearing design and give a better understanding of desirable behavior in greases.

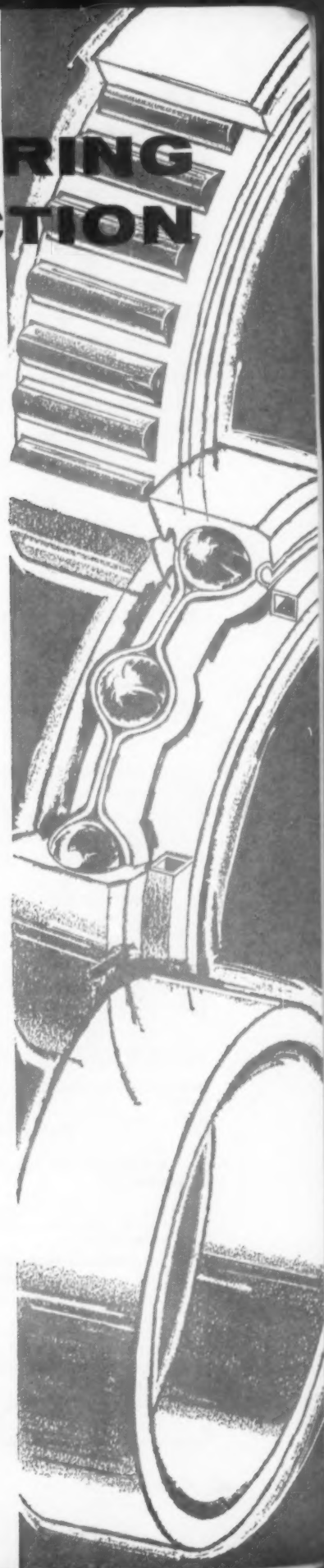
Johnson Bronze Co.—appointed **Myron K. Boatman** chief manufacturing engineer and **Edward O'Leary** materials manager.

Kaydon Engineering Corp.—reduced prices, effective August 28, on precision loose needle rollers. This is the second price cut made by Kaydon in less than a year. The first was made after employees volunteered to establish lower incentive rates, but increase productivity, thus not affecting take-home pay. The second price cut comes from reduced costs, improved methods and automation of some operations.

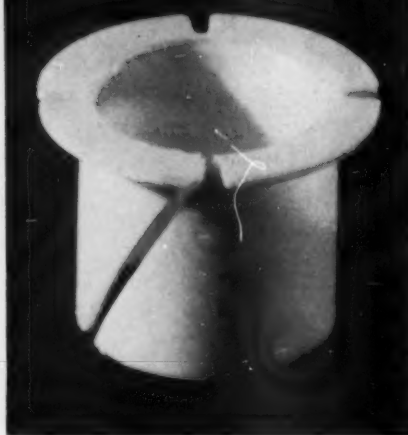
Dunn Engineering Corp.—was awarded a National Aeronautics and Space Administration contract for an advanced air bearing turntable to evaluate the equipment that will guide the giant Saturn rocket. With a capacity of 500 lb, the turntable will be the largest precision air bearing unit ever made. Other specifications: Turntable axis runout— ± 1 arc seconds; turntable face runout— ± 3 arc seconds; axis orthogonality— ± 3 arc seconds; direct-drive torque motor; table-top diameter—36-in.

Federal Mogul Bower Bearings, Inc.—appointed **John E. Brennan** a vice president of the Corporation and general manager of the International Division.

This Division comprises eight manufacturing facilities that have been wholly or partially acquired during the last three years. They include engine bearing plants in France and Argentina, a roller bearing plant in Argentina; an oil seal plant in Spain; an engine bearing and oil seal plant in Mexico; and three plants in Canada.



Fillers and reinforcing agents have increased the wear resistance of Teflon (TFE) fluorocarbon resins more than 1000-fold. At the same time, deformations under load and coefficient of thermal expansion have decreased. The resins have a wide range of operating temperatures, and high chemical resistance. With these natural assets, engineering ingenuity has devised a multitude of uses, types, and varieties of . . .



TFE tape-lined bearings

By SAUL RICKLIN, Vice-president, Dixon Corp.

BECAUSE TFE RESIN CONDUCTS HEAT so poorly, the performance of solid bearings is limited to comparatively low loads and speeds by heat generated at the rubbing surface. Various techniques have been used to increase the permissible loads and speeds. A simple, economical one is to use thin split tape inserts of reinforced Teflon, commonly called "tape liners." They give excellent results.

Tape-lined bearings have these advantages over molded or machined sleeve bearings of the same material:

- Increased maximum PV limit from 10,000 to 20,000. This is for nonlubricated, unidirectional load, 1000-hour life.

WHERE TO USE THEM

Reinforced TFE tape-lined bearings are recommended for:

1. Low cost, high performance dry bearings for continuous service to 20,000 PV, or intermittent service to 50,000 PV.
2. Low temperatures to -450°F (where oils are useless).
3. High temperatures to 500°F .
4. Corrosive substances, nonlubricating liquids, high or low humidities.
5. Lubricated applications where wear may occur during starting and stopping.
6. Oscillating bearings or any case where stick-slip is undesirable.
7. Space and weight saving applications.

Other conditions will permit higher than 20,000 PV for tape liners.

- A minimum of material is used. No scrap loss or machining cost as with other types.
- Less deformation for a given load with the thin tape-lined bearing, because deformation under load is in in. per in. of thickness. Also, thin tapes show less deformation as in. per in. of thickness than thick tapes. And tape liners can be oriented to show a minimum deformation under load.
- The split construction, leaving a small gap, allows circumferential thermal expansion and contraction without ID change. This eliminates a major defect of other plastic sleeve bearings.
- Free rotation of the lining reduces localized wear with unidirectional loads.
- Provides an extremely light compact bearing.
- Produced by simple stamping from off-the-shelf tapes from 0.005 in. to 0.125 in. and widths up to 24 in. Bearings of any size are readily made without expensive tooling.
- Tape liners, with their thin walls, dissipate heat better than TFE bearings.

Ways of making tape-lined bearings

Tapes 0.015 in. to 0.060 in. are used, with 0.030 in. being most common. Lighter tapes are best for small diameter shafts at low loads and speeds where proper retention can be provided.

Retention of tape liners:

- Stock bearings come with steel shells formed with retaining lips on each end (similar to drawn cups for

needle bearing shells) with tape liner inserts. Tape and shell have 1/16-in. total wall thickness and press-fit in use.

- Undercuts on the shaft or in the shaft housing will retain the tape. The undercut is usually 1/2 to 2/3 the tape thickness. Thus 0.030 in. thick tape would call for undercuts of 0.015 in. to .020 in.
- Shoulders, blind holes, metal or reinforced TFE tape thrust washers, or other components on the machine can be used to retain the tape.

The tape ends are usually cut at an angle to avoid concentrating the bearing load on the gap. The gap width is not critical and should merely be wide enough to prevent overlapping on installation. Gaps of 1/32-in. to 1/16-in. are common. For very small bearings the ends are usually cut square for easier installation.

Clearances

Tape-lined bearings perform best with initial clearances of .002 to .003 in. Less may cause premature failure because of thermal expansion and deformation. Remember that plastic bearings are soft enough to conform to the shaft so that actual clearances are usually zero in the loaded area.

Surface Finish and Shaft Material: Surface finish of mating members is less critical than required with metal bearings. Good results are obtained with finishes better than 30 microinch (RMS) with 15 microinch being a recommended figure. A slight roughness helps transfer TFE resin to the shaft, which lowers the friction.

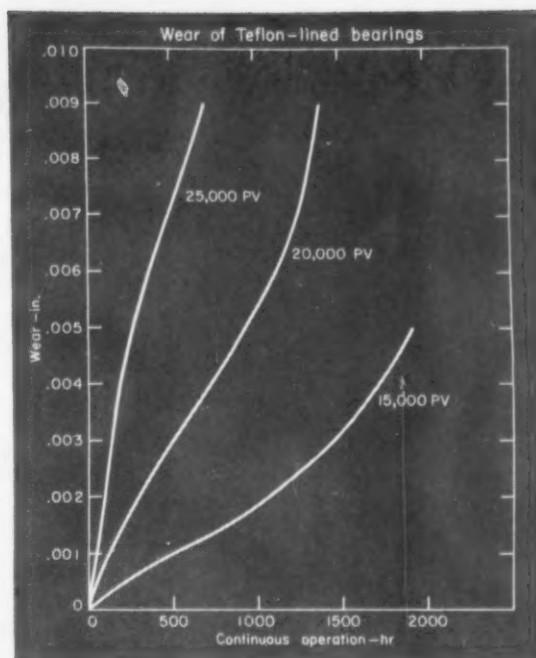
Hard shaft materials work best, with Rockwell C65 giving considerably longer wear life than cold rolled steel shafting. Chrome plating can help with softer shaft materials.

Load and Speed: Tape liner bearings have run continuously for over 1000 hr at 20,000 PV (dry) with unidirectional load. Maximum load is 2000 psi and maximum speed 400-500 fpm, although higher speeds have been used successfully at lower PV factors.

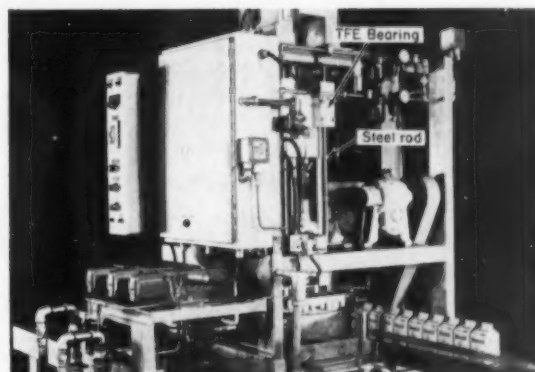
The maximum PV is limited by the heat generated so that these figures can be improved by air cooling, housing fins, intermittent service or lubrication. In one test, a 1/2-in. ID x 1/2-in. long tape-lined bearing ran for 1000 hr at 200 fpm and 100 psi (20,000 PV). It was in continuous service with a 250 F housing temperature. An identical bearing gave 1000 hr service at 50,000 PV (200 fpm, 250 psi) when run intermittently to limit housing temperature to 250 F. This bearing ran for over 5000 hr with no wear shown at 60,000 PV (200 feet per minute, 300 psi) when oil lubricated.

How much friction? Reinforced TFE Tape lined bearings coefficients of friction are about 0.15 to 0.25 under normal dry conditions. At speeds below two feet per minute, the coefficient may be as low as 0.04. This low speed phenomenon, plus the fact that the static coefficient is lower than the dynamic, eliminates stick-slip. The bearings actually perform best in oscillating mechanisms, just where other types perform least well.

Does it resist corrosion? There are reinforced TFE resins which are inert to practically everything but molten sodium. Moisture absorption is essentially zero, sunlight and aging have no effect. Actually, perform-



WEAR for TFE Teflon-lined bearings is considerably higher than for metallic bearings, as would be expected. But their ease of replacement, and low cost easily make up for the high wear rates. Bearings used to produce the curves above were 1/2-in. in diameter. They were run continuously at 1750 rpm on a drill rod shaft.



THE ELEVATOR that lowers milk containers into their cases slides up and down on three 1-in. diameter rods. The original ball bearings were replaced with Teflon-lined bearings to eliminate lubrication difficulties. The light loads involved, and the impermeability of Teflon make these sleeve bearings ideal for this application.

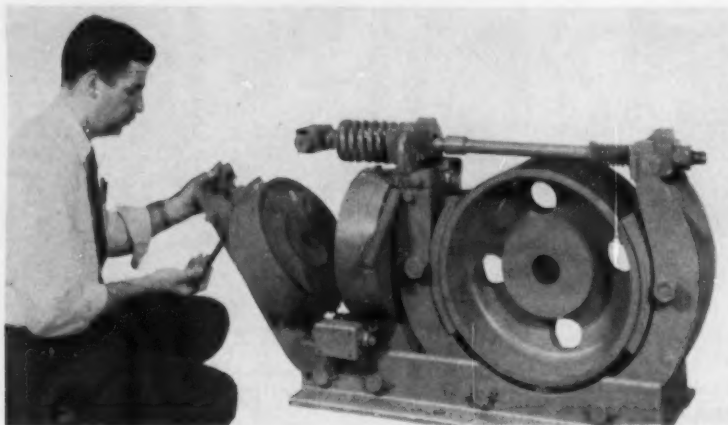
ance is improved when the bearings run submerged in water, hydrocarbons, solvents, or chemical solutions.

While abrasive dirt is never desirable, tape liners are much more tolerant of these conditions than other bearings. They can actually engulf the dirt particles. Misalignment will shorten bearing life but tape liners are not badly affected. They can conform to misalignment conditions and thereby adjust the load carrying area.

PRODUCT NEWS

Twin magnet dc brakes

Type TM for heavy duty steel mill crane service, etc. Coils can be replaced while brake is under load.



Available at 115, 230 and 550 volts, in wheel diameters 8 through 23-in. The independent magnet assemblies lift out for repair without releasing the brake or changing the torque setting. Single pivot-mounted cast iron brake shoes with brass-riveted molded asbestos linings. Bearings are Oilite, mounted

on oversize case hardened pins. Fabricated steel base. Tie rod and spring assembly lifts off as one piece for easy brake shoe replacement. Ductile iron brake wheel instead of annealed iron castings is standard alternate for the same price. Westinghouse Electric Corp., Pittsburgh, Pa.

Circle 200 on Reader Service Card

Inertia-type gear analyzer

Electrical indicators show three gear tooth accuracy measurements

The Red Ring analyzer checks gears for accuracy of eccentricity, tooth-to-tooth action, over-size and

undersize. It will detect nicks on profiles of 0.0005-in. The pivoted master gear shaft is belt driven by



a universal motor mounted on a cast iron base. Electrical indicators have repeat accuracies of less than 1/10,000-in. Center distance capacity from 1 7/8 to 12 15/16-in. Adjustable spring mesh control keeps the master gear in contact with work gear. National Broach & Machine Co., Detroit, Mich.

Circle 201 on Reader Service Card

Unbalance indicator

Shows the amount (in vpm) and angle of vibration caused by an unbalanced rotating part.



The PSUI (pulse synchronized unbalance indicator) filters by synchronous rectification circuits. These reject noise through an operating range of 500 to 5000 rpm (standard) or up to 50,000 rpm (custom). The synchronizing pulses are picked up from the rotating part itself by a magnetic photocell or capacitive pickup. A ten millivolt peak-to-peak input signal from the vibration pickup produces a full-scale deflection.

Dimensions: 9 x 14 x 20 in.; weight is 40 lb. Electrical input is 110 vac, 50 to 400 cycles. General Motors Research Labs., Warren, Mich.

Circle 202 on Reader Service Card

For more information on these products, use Readers Service Card on page 49. For more Product News, see page 52.

OIL SEALS in Design Engineering



Garlock KLOZURE® Oil Seals stop oil leakage at bearings, increase efficiency of Denison Variable-Volume Hydraulic Pumps.

Denison designs hydraulic pumps around Garlock KLOZURE Oil Seals to assure maximum sealing efficiency.

Where pressures are too high for ordinary lip seals, KLOZURE Oil Seals prevent leakage of hydraulic oil and protect vital bearings as temperatures reach 150°F, pressures rise to 35 p.s.i., and shafts whirl at 1800 r.p.m. In use for the last twelve years, the seals have given complete satisfaction on the well-known line of axial piston and vane-type pumps made by Denison Engineering Division of American Brake Shoe Company.

Wherever bearings must have the best protection, Garlock KLOZURE Oil Seals are specified. On pumps like Denison . . . in steel mills . . . on power shovels and lift trucks . . . for motors, KLOZURE Oil Seals prevent leakage of lubrication, seal out harmful foreign matter. Whatever the application, there is KLOZURE Oil Seal to do the job. They are oil and grease resistant, impervious to mild acids and alkalis, non-abrasive, and will withstand temperatures from -40°F to +250°F. For extreme conditions, Garlock furnishes sealing elements resistant to practically any fluid, and serviceable as high as +500°F.

Availability is another prime reason for selecting Garlock KLOZURE Oil Seals. Once your design is finalized, you may select the proper seal from over 1800 stock items available from 180 national bearing distributors, including one near you.

It makes good sense to design with KLOZURE Oil Seals, as Denison and hundreds of other leading companies have found. See how you can benefit—call in your local Garlock representative. You will find him at the nearest of the 26 Garlock sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-181. Garlock Inc., Palmyra, N. Y.

GARLOCK

Canadian Div.: Garlock of Canada Ltd.

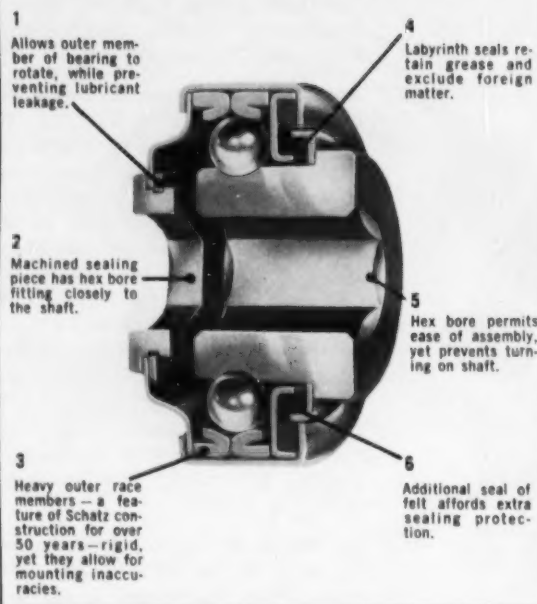
Plastics Div.: United States Gasket Company.

Order from the Garlock 2,000 . . . two thousand different styles of Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastics Products.

*Registered Trademark

When low bearing cost is a must...

but you need all these features, too



This is Schatz "Commercial" Ball Bearing #CS-3174x3. It is prelubricated, ready for heavy duty.

And, it is cutting costs on production lines everywhere—both by its initial price and through its operating performance.

Given the right applications, "Commercial" ball bearings can shave *your* component budget, too. Schatz engineers have been doing it for industry for over 50 years. For the complete line of Schatz bearings has been designed to provide

all the precision you require—and need pay for—for numerous applications.

Let us show you how these cost-saving bearings fit your production program. Write for Catalog 12.

The Schatz Manufacturing Company, 7640 Fairview Ave., Poughkeepsie, N. Y.

See our ad in SWEET'S

SCHATZ
"Commercial"
BALL BEARINGS

Circle 35 on Reader Service Card

TORSIONAL VIBRATION

continued from page 40

shafts. Corrective devices are available; one successful one will be discussed later.

Allowable Shaft Stresses

Shafts designed to the rules of ship classification societies (American Bureau of Shipping, Lloyds, etc.) generally tolerate higher torsional vibration stresses. Depending on shaft type, size, and material, the allowable shear stress for continuous operation may increase by $\pm 3,000$ psi to $\pm 10,000$ psi. Higher stresses can be tolerated for short periods, such as passing through critical speeds in starting, stopping and maneuvering. Torsional vibration control devices can reduce stresses that are too high.

Part 1 in this series of four articles on Torsional Vibration dealt with fundamental theory and included a glossary of terms. Part 3 will describe the effects of torsional vibration on transmission systems with particular emphasis on gearing. Part 4 deals with damping techniques.

Shafts are not always designed with the same margin against fatigue failure that the societies provide. Overloading, shock, and other factors may be present in transmission systems that reduce allowable stresses to as low as $\pm 1,000$ psi. The variable-combined fatigue stress theory can be used to evaluate allowable torsional stress in each case, or to establish design requirements for any superimposed torsional vibration stress.

Since the number of vibratory stress cycles accumulated in even a few days of operation can reach into millions, the vibration frequency, unless extremely low, has no bearing on allowable stress. ♦

ECONOMICAL GENERATOR

continued from page 31

A heavy overload will lower the voltage and frequency, but there is no danger of stalling or damaging the engine.

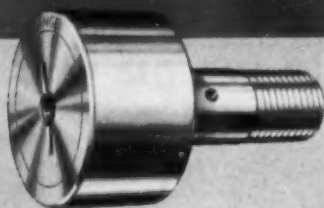
This ability to meet an overload by putting out a higher torque at reduced speed is a fundamental advantage of the free turbine. It provides automatic overload protection that is limited only by the permissible drop in frequency and the current capacity of the generator.

• **Over-all Advantages**—This compact, self-contained power pack costs less than any other generating set of similar capacity. It needs little maintenance—a visit every three or four months and an overhaul every 10 years when used for peak lopping or similar intermittent duties will suffice.

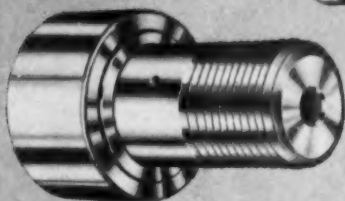
Air intake and exhaust systems are quiet enough for residential areas. A fuel control system has been designed that permits the use of natural gas with no loss of performance. ♦

Give your Cam-Activated, Guide and Track Applications the ultimate in smooth, rugged, shockproof operation!

TYPE S
Standard Stud

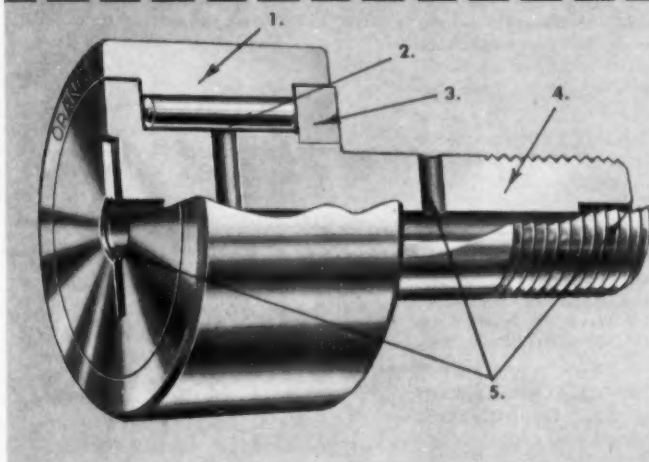


TYPE H Heavy Duty Stud
Provides an average of 20% greater beam strength of the stem where severe operating conditions exist.



ORANGE CAM FOLLOWERS

Orange Cam Followers are engineered and constructed to provide the maximum in precision, friction-free, durable service for follower roller mechanisms. Available in 22 standard sizes from 1/2" to 4" O. D., with either standard or heavy duty studs. Chrome, Cadmium or Black Oxide finishes can be supplied; also seals where conditions require. Check these features!



1. Centerless ground, heavy-sectioned outer race is made of thru-hardened, high quality bearing steel. Precise concentricity provides true radial running, prevents vibration to protect delicate mechanisms.

2. Small diameter rolls are made of high grade bearing steel, electronically gauged for uniformity of size.

3. Case-hardened end plate permits the use of effective press fit for retention.

4. Induction-hardened stud assures maximum hardness of the roller surface, with core toughness to withstand high shock loads. Slotted ends for convenient screw driver mounting.

5. Selective lubrication for design flexibility. Drilled for drive type fitting. Closing plugs also furnished.

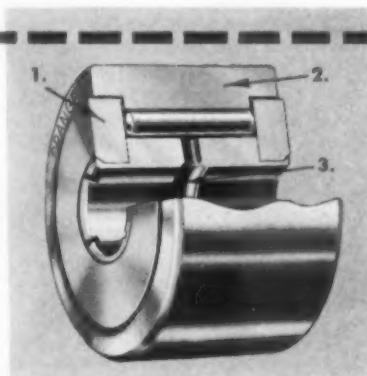
ORANGE CAM YOKE ROLLERS

Simplified, rugged construction is ideal for yoke mounting in machinery involving cam action or control of machine elements requiring guide or support rollers. 18 sizes from 3/4" to 4" O. D. Can be furnished with Chrome, Cadmium or Black Oxide finishes. Supplied with seals where required.

1. Staked end plate. The inner race is zone-hardened on the roller path for wear-resistance, while the ends remain more ductile to permit substantial staking for self-retention.

2. Heavy outer race centerless ground to precise concentricity and thru-hardened to carry heavy loads.

3. Lubrication passage provided from center channel.



WRITE FOR 44-PAGE REFERENCE MANUAL giving full specifications on Orange Cam Followers and Yoke Rollers, plus complete line of Orange Roller Bearings.

ORANGE ROLLER BEARINGS

ORANGE ROLLER BEARING CO., Inc.
552 Main Street, Orange, N. J.

Needle Bearings — Staggered Roller Bearings
Journal Roller Bearings — Thrust Roller Bearings
Cam Followers



FREE REFERENCE MATERIAL from this month's ads

Readers may obtain any of these reference materials by circling the numbers on the reader service cards.

OFFERED FOR THE FIRST TIME . . .

The services and reference materials listed here are being offered by advertisers to readers for the first time

2. LIQUID METAL SEALANT—American Sealant Co.'s Loctite Sealant simplifies shaft assembly problems, ends vibration loosening. Literature and free samples.

3. BEARING BRONZE—ASARCO offers literature on continuous cast bearing bronze in diameters and lengths close to finished requirements.

4. SPEED REDUCERS—American Stock Gear Div.—Write for illustrated catalog to help you on your next reducer application.

8. CHAINS, SPROCKETS—Chain Belt Co.—Send for data on the Rex sprocket line to get the right sprocket for the job.

9. CUSTOM GEARS, BOXES—Brochure covers facilities for gear making and inspection, plus selection data.

10. TORQUE LIMITERS—Conway Clutch Co. will send details, bulletins on coil spring torque limiters.

11. TEMPLATE KIT—Crown Gear Co. has a kit with 18 basic right angle units on 6 full scale template sheets.

12. SPROCKETS AND ROLLER CHAINS—Cullman Wheel Co.'s literature to help with chain drive problems of all types.

13. OVERLOAD SAFETY DEVICES—Dalton Gear Co.—OSD Catalog 961 deals with both basic unit and a combination safety coupling.

14. BEARINGS—Dodge Mfg. Corp.—Bearing Bulletin lists more bearings than you have bearing problems.

15. GEAR MOTORS—Georg Von Opel Corp. offer catalog on the Bauer helical gear motor which mounts in any position.

16. FLEXIBLE SHAFTS—Elliott Mfg. Co.'s Catalog 263 presents data for designers on flexible shafts. You can cut costs, eliminate moving parts.

20. UNIVERSAL JOINTS—The Gray & Prior Machine Co. Fifteen sizes in steel. Bronze, monel and special metals available. Catalog gives data, specs.

21. ADJUSTABLE SLIP CLUTCH—Hilliard Corp.'s clutch limits torque, resumes drive after overload, has optional adjust-while-running feature. Details in Bulletin 300.

6. CHAINS, COUPLINGS—Atlas Chain—Technical data for selection of roller chain in slide rule form. Covers most types and materials.

43. RIGHT ANGLE GEARMOTOR—U. S. Electrical Motors, Inc.—Illustrated brochure No. F. 1971 on worm gear types, 1/3 to 2 hp.

22. BIG GEARS—Horsburgh & Scott Co.—Spur, helical, herringbone, to custom requirements, plus standard and special speed reducers. Catalog FLB-60.

24. OVERLOAD CUTOUT—Janette Div., National Pneumatics—Color coded interchangeable springs to adjust torque limit. Bulletin 5-7 for details.

UNIVERSAL JOINTS—Lovejoy Flexible Coupling Co.—Write on company letterhead for Bulletin D-61 covering single, double and booted types in wide range of sizes.

26. BELT AND CHAIN DRIVES—Maurey Mfg. Corp.—Catalogs and manuals on request cover fhp, multiple-V, Super-Wedge and compact positive belts, variable speed drives and roller chain drives.

27. CLUTCHES—Minster Machine Co.—Clutch Conversion Booklet CC shows the advantages of air clutches for press conversions.

28. VARIABLE SPEED BELT—Manheim Mfg. & Belting Co.—Write for complete info on MVS belt to replace enclosed drive belts without disassembly.

29. CAM FOLLOWERS—Orange Roller Bearing Co.—Reference Manual, 44 pages, gives full specs on cam followers and yoke rollers, plus complete line of roller bearings.

31. POLY-V BELT—Raybestos-Manhattan's Bulletin M 141 tells you how to get more use per dollar by converting your present drive.

32. SPRING LOADED CLUTCHES—Rockford Clutch—Write for complete details of clutches and design engineering service for applying them.

45. ELECTRIC CLUTCH—Warner Electric Brake & Clutch Co.—The new SF. 500 offers up to 50 ft lb static torque. You can fit it in to small space without reworking or machining. Stationary field, torque ratings from 1.5 in-lb to 1350 ft-lb. Write for details.

35. BALL BEARING—Schatz Mfg. Co.—How to fit cost-saving bearings in your production program. Catalog 12.

37. CLUTCH/BRAKE UNITS—Simplatrol Products Corp.—Complete literature covering standard and custom designs. Units have only one moving part.

38. ELECTRIC DISC BRAKE—Stearns Electric Corp.—Spring-set, solenoid-released disc brake for 40 frame fhp motors. Details in New Product Preview 1-61-B.

39. FLEXIBLE SHAFTING—Stow Mfg. Corp.—Torque calculator comes with Engineering Bulletin No. 570. Shows how to select flexible shafting for power drives.

41. MAGNETIC DRIVES—Tormag Products Div.—Permanent magnets form a cushion to reduce shock, stop burnout from jams. Write for catalog TP260.

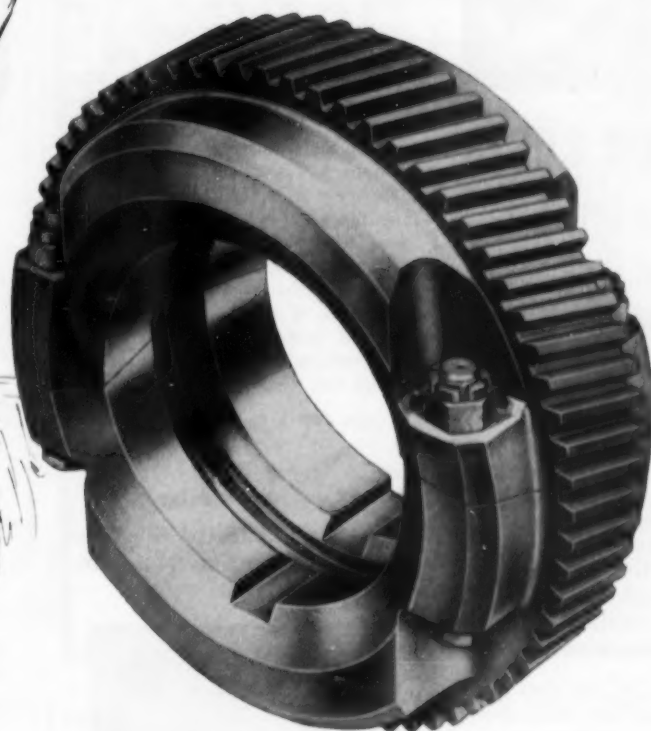
42. PILLOW BLOCKS—Triangle Mfg. Co.—Self-aligning, self-lubricating, sleeve type. Literature gives details.

48. GEARBELT DRIVES—Browning Mfg. Co.—Catalog GB-201 tells you how to pack a high capacity drive in limited space with no stretch or takeup.

50. FLEXIBLE GEAR COUPLING—Sier Bath Gear & Pump Co.—Design Catalog on the Mite nylon sleeve coupling. Speeds to 5000 rpm without lube.

52. CENTRIFUGAL CLUTCHES—Formsprag Co.—Catalog shows how to eliminate costly low voltage starting equipment with No Load clutches.

53. VARIABLE SPEED DRIVES—T. B. Wood's Sons Co.—Drives using conventional V-belts from fractional to over 300 hp. See Bulletin 6102.



Outstanding Performance...

CINCINNATI

CUSTOM GEARS AND GEAR BOXES
are *outstanding performers* — the
result of old-fashion craftsmanship
applied to latest techniques and ma-
chines for gear making and inspection.



Ask for this brochure—CINCINNATI cus-
tom gears are made in all types to 72"
diameter cut teeth, 39" shaved teeth, 25"
ground teeth.

better still . . . Send us your prints for quotation

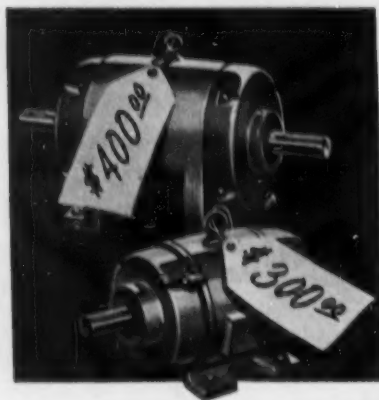


THE CINCINNATI GEAR CO.

Cincinnati 27, Ohio

Custom Gear Makers Since 1907 GEARS, good gears only

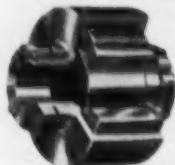
Circle 9 on Reader Service Card



CUT MOTOR COSTS

with "No Load"

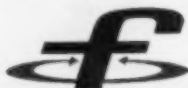
Centrifugal Clutches



Cushioned "no load" starts for high inertia and hard-to-start loads eliminate need for costly low voltage starting equipment, oversize and high torque motors and permit smaller, general purpose motors to be used.

- New design "A" Series centrifugal clutches are available for direct drive, shaft-to-shaft installations, also replace flexible couplings.
- Standard model capacities range from fractional hp to 3,000 hp with bore diameters from .500" to 8.375"
- Positive protection—in the event of jamming or overloading—is provided through automatic disengagement of clutch.

For more details write for Centrifugal Clutch Catalog, or contact your local Formsprag distributor.



**FORMSPRAG
COMPANY**

23587 HOOVER ROAD, DEPT. 122
WARREN (DETROIT), MICHIGAN

Precision Power Transmission Products
Circle 52 on Reader Service Card

PRODUCT NEWS

Spliced polyester belts

Ultrasonic splicing method produces joints 90-100 percent as strong as belt.

Mylar belts in any lengths (widths from 1/4-in. or less to 60-in., thickness 1-10 mils) are spliced by traversing the lapped ends with an ultrasonic vibrating horn. This transmits energy through the polyester so that the surfaces to be joined are brought within atomic distances of each other and adhere positively with only mild clamping pressure. Minimum overlap, so flexibility is unaffected.

Same method is used on Cronar belts (widths from 16 to 70 mm, thickness 4 or 7.5 mils) or on coated, perforated belts supplied by customer. International Ultrasonics Inc., Cranford, N. J.

Circle 203 on Reader Service Card

Screw conveyor drive

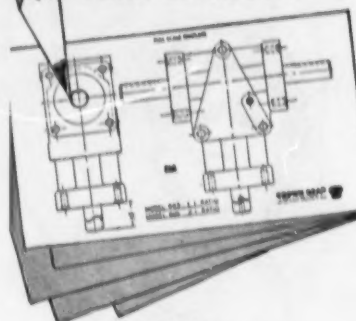
New size in the Screw King line covers hp from 1/2 to 30, speeds from 5 to 350 rpm



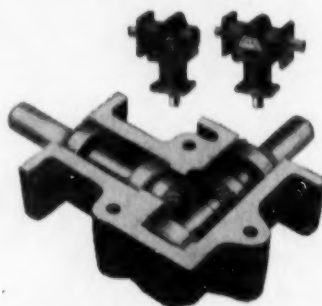
The #5 Screw King comes in two ratios, 13:1 and 20:1, covering up to 20-hp at 73-rpm, and 30-hp at 120-rpm. Output shaft sizes of 2 in., 2 7/16-in., 3-in., and 3 7/16-in. The drive is a double-reduction speed reducer with integral drive shaft and support bearings. The trough and adapter is punched to match standard conveyor troughs. No special mountings or extra drive-end bearings are needed. American Pulley Co., Philadelphia, Pa.

Circle 204 on Reader Service Card

THESE TEMPLATES...



THIS CROWN "PACKAGE"



wrap up
your right-angle
design problem!

... And the transition to the "Package" concept of right-angle power transfer is that simple with this easy-reference template kit. 18 basic Crown right-angle units are shown on six template sheets, each full scale.

WHY spend countless hours on research and drawings? WHY purchase expensive patterns, core boxes, castings, steel and other materials? WHY manufacture fixtures and gages? WHY machine, inspect, assemble and test components?

WHY NOT OBTAIN THE IDEAL SOLUTION TO YOUR RIGHT-ANGLE PROBLEM . . . IMMEDIATELY, AND AT TREMENDOUS SAVINGS?

Your local Crown Gear Distributor (Listed in Power Transmission Design Directory) has the answers . . . and your Template Kit. Call him or consult factory.



**CROWN
GEAR**

320 PARK AVE., WORCESTER 10, MASS.
A Division of Harrington & Richardson, Inc.

Circle 11 on Reader Service Card
POWER TRANSMISSION DESIGN

Motor speed controls

Off-the-shelf ac controls for dc motors

The VT series work from standard 50/60-cycle ac single-phase 115v (or 230v in 1-hp and larger



models). Hp range from 1/12-hp through 3-hp in 15 standard models. Infinitely variable speed from zero to maximum motor rpm in either direction (reversing switch is included in control). Standard industrial electrical (not electronic) components. Controls are easily connected to standard dc shunt or compound-wound motor. Remote control models also available. *Pacific Industrial Controls, Inc., Berkeley, Calif.*

Circle 205 on Reader Service Card

Fractional hysteresis clutch

Synchronous driving or continuous slip, with negligible torque variation at any slip differential

Essentially a power dividing device, with torque output proportional to a dc control current.



No mechanical connection between input and output shafts, except the shaft support bearing. Residual torque at zero excitation is bearing friction only. Clutch shown is 1/20-hp at 1800-rpm, measures 2 1/2 in. OD. Design comes with or without pillow blocks, mounting bearings, drive gears, etc. *Scanner Corp. of America, Livonia, Mich.*

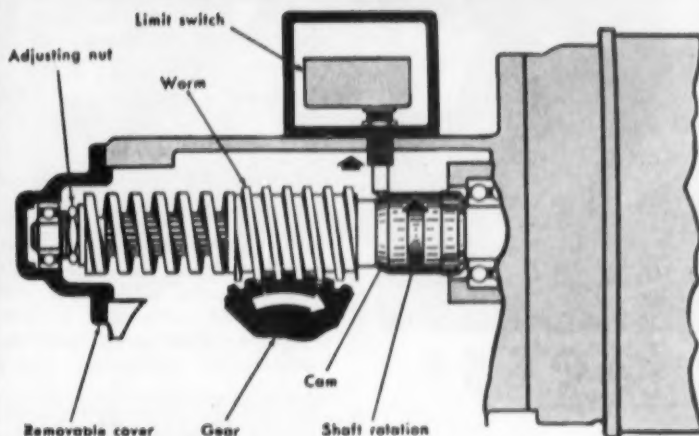
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Preloaded precision bearings

Eliminate end shake and mismatching of different pairs

Known as Pre-Paired, the pre-loaded bearings are made by a new

NOW POSITIVE PROTECTION for MOTORS and MACHINERY



As long as applied torque is within pre-determined limit, spring bears against end of worm and holds it centered on gear. Excessive torque causes worm to move axially along splined motor shaft, compressing spring and bringing cam surface in contact with limit switch which cuts power, stopping motor.

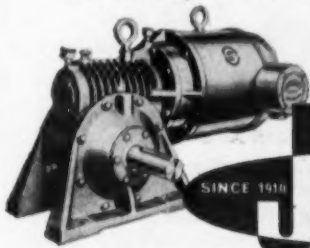
...JANETTE Adjustable Torque Overload Cutout

Here's *dependable* protection for drive units, driven mechanisms, personnel, and work in progress . . . and a sure-fire way to reduce down-time.

Janette Adjustable Torque Overload Cutout is far more sensitive than conventional shear pins, or friction clutches and similar devices. Its sliding worm on a spline shaft (described above) assures shutdown of the driving motor within closely controlled torque overload limits. Unit is easily reset when cause of overload is removed.

Color-coded, interchangeable springs permit selection of a wide range of torque limits. Each spring has a simple linear adjustment over its own range. Protect *your* equipment and avoid costly downtime the *positive* way . . . with Janette Adjustable Torque Overload Cutout.

Write today for Bulletin 5-7.



Janette

GEAR MOTORS
MOTORS
SPEED REDUCERS

Division of National Pneumatic Co., Inc., Boston 19, Mass.

Circle 24 on Reader Service Card



Save \$\$\$\$

ATLAS UNIVERSAL JOINTS

Balanced to operate without vibration at all speeds. Short, stubby jaws give maximum resistance to spread. Larger diameter joints fitted with big grease reservoir. Standard alloy steel joints in fifteen sizes for all requirements. Also made in Bronze, Monel and other special metals.

Universal Slip Shafts a specialty.

WRITE for illustrated catalog giving data and specifications.

WEST COAST REPRESENTATIVES

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THE
**GRAY & PRIOR
MACHINE CO.**

607 WINDSOR ST.
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Circle 20 on Reader Service Card

PRODUCT NEWS

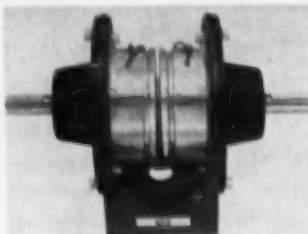
method that permanently joins the two inner (or outer) rings of a pair while offsetting the two outer (or inner) rings by means of precision shims. Two bearings of a matching duplex pair become a single unit. For gear trains, computer assemblies, etc. *The Barden Corp., Danbury, Conn.*

Circle 207 on Reader Service Card

Electric clutch/brake drive

Fractional hp, for OEM and user duty-cycle conversions

Pre-assembled Electro-Pack drive combines clutch and brake in a pre-aligned unit with input and output shaft extensions. It bolts into place without special mounting hardware or machining. Heavy



duty bearings with a common splined armature hub for both clutch and brake. Three sizes: 10, 60 and 240-in. lb static torque for max. shaft speeds of 10,000, 7500 and 5000-rpm. *Warner Electric Brake & Clutch Co., Beloit, Wis.*

Circle 208 on Reader Service Card

Speed changer

Expanded line, from 1 to 30-hp, aimed at system and process automation field.



The Vari-Tex gives stepless changes within standard ranges of 2:1 through 10:1 at speeds from 1.8 to 4460-rpm. Mechanical, electrical and pneumatic control options.

ASARCON

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Pittsburgh
Pittsburgh Brass Mfg. Co.
ATLANTIC 1-8741

RHODE ISLAND
Providence
Clifford Metal Sales Co., Inc.
UNION 1-4100

SOUTH CAROLINA
Greenville
J. M. Tull Metal & Supply Co., Inc.
CEDAR 1-8360

TENNESSEE
Memphis
Memphis Bearing & Supply Co.
JACKSON 6-7543

TENNESSEE
Nashville
Davis Bearings, Inc.
CHAPL 2-7551

TEXAS
Beaumont
Standard Brass & Mfg. Co.
TERMINAL 3-2641

TEXAS
Houston
Standard Brass & Mfg. Co.
RI 7-1220

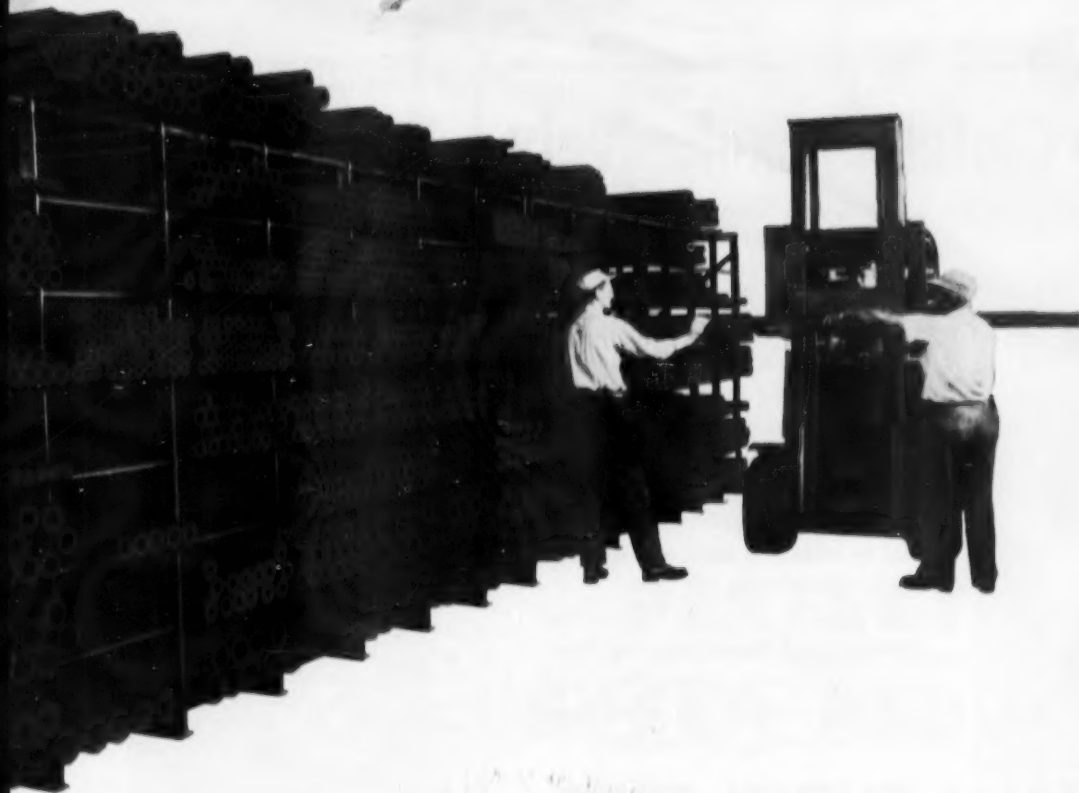
TEXAS
Port Arthur
Standard Brass & Mfg. Co.
YUKON 5-8977

WISCONSIN
Milwaukee
Balzer Bearing Co.
BROADWAY 2-0291

CANADA
Lachine, Quebec
Federated Metals Canada, Ltd.
MELROSE 7-3581

CANADA
Scarborough, Ontario
Federated Metals Canada, Ltd.
PLYMOUTH 7-3268

Circle 3 on Reader Service Card
POWER TRANSMISSION DESIGN



ASARCON[®] 773 BRONZE

AVAILABLE OFF-THE-SHELF

ASARCON CONTINUOUS-CAST BEARING BRONZE

IN STOCK SIZES 1/2" TO 9" O. D., ANY LENGTH TO 105"

When you order Asarcon 773 (SAE 660) continuous-cast bearing bronze, you receive the length and size you specify without delay. You choose from more than 260 stock sizes — solids and tubes — and have your order cut in any length up to 105". A nation-wide network of conveniently situated distributors assures prompt deliveries.

By providing diameters and lengths close to your finished requirements, Asarcon 773 substantially reduces the cost of scrap. With only 1/32" to 3/32" to machine off, there is more usable metal, machining time is reduced, work moves faster.

Asarcon 773 has unusually high density, because it is produced by the unique, patented continuous-cast process. Every casting has more resistance to metal fatigue, superior hardness, higher tensile, yield and impact strength . . . and each is guaranteed free of blow holes, shrinks, voids, pits.

For further information, call or write your nearby distributor (see listing on opposite page), or write Continuous-Cast Department, American Smelting and Refining Company, Perth Amboy, N. J.



Quality Clutches Exclusively



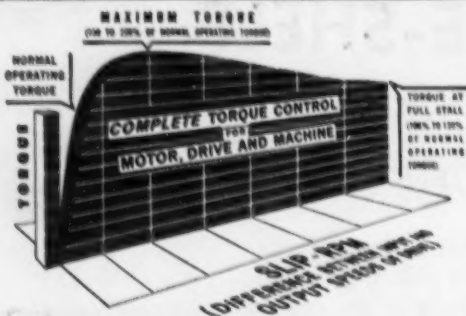
These **Over-Center Clutches** are General Purpose, heavy duty, friction clutches for machines requiring high quality dependable clutches with low power losses, low upkeep, and long life. Built in *Flex-Disc*, *Solid Disc* (two halves), and *Gear Tooth* types.

Five sets of over-center toggles provide two to three times greater bearing surface. Easily adjusted for wear by releasing latch and turning toggle assembly.

We offer a complete Clutch Engineering and Manufacturing Service — designing, producing, and applying clutches to meet any conditions arising in industry.

INDUSTRIAL CLUTCH CORP.

515 Frederick St. • Phone Liberty 7-3359 • Waukesha, Wis.



Add this **Safe** controlling device to **your** equipment with **GLEASON-**

TORMAG® Magnetic DRIVES



It's the best way to prevent motor burnouts, broken machine parts, product spoilage, production downtime . . . GLEASON-TORMAG Drives with permanent magnets give you a "cushion" on every installation that will minimize overload shocks, reduce heavy starting loads, prevent damage from jams and stalls, and permit motor operation without over-heating and damage. No fluids, particles, seals, brushes, or exciters to require maintenance.

Add this protection now — write on your company letterhead for new catalog TP260 and engineering suggestions.

TORMAG PRODUCTS Division, Gleason Keel Corp.
739 N. Plankinton Ave., Milwaukee 3, Wis.
Representatives in Foreign Office in U.S. and Canada

Circle 41 on Reader Service Card

PRODUCT NEWS

Vertical, horizontal or 45 degree assemblies, with drip-proof, totally enclosed, or explosion-proof Super-Seal or Synduction motors. Integral single, double or triple reduction gear units if needed. Compensating spring system retains proper belt tension for automatic pitch changes of driven sheave. *Allis-Chalmers Mfg. Co., Milwaukee, Wis.*

Circle 209 on Reader Service Card

Belt tension dial gauge

Measures V-belt tension directly in pounds strand tension

You depress plunger, engage belt, release plunger to check tension with maker's specifications. Span between centers, pulley size, and other variables do not affect accuracy of reading. Two models: 33-73-A with range type dial, and 33-73 with numbered dial. *Borroughs Tool and Equipment Corp., Kalamazoo, Mich.*

Circle 210 on Reader Service Card

TRIANGLE BEARINGS with *Engineered* INDIVIDUALITY

Triangle fits the bearing to the application. Whether you can use a standard, like the Pillow Block above, or need a special such as the Pedestal or Clamshell Bearings shown below, your particular bearing problem receives the individual attention best assuring cost reductions — quality improvements.

SELF-ALIGNING . . . SELF-LUBRICATING SLEEVE-TYPE PILLOW BLOCKS



The widest selection of mountings available — functionally designed, efficiently produced. Experienced sales engineers available to help you anywhere. Phone or write for descriptive literature.



TRIANGLE MANUFACTURING Co.

734 Division St.

Oshkosh, Wisconsin

Circle 42 on Reader Service Card

POWER TRANSMISSION DESIGN

Auxiliary governor for PTO control

Automatically adjusts power supply to keep PTO speed constant.

The governor is mounted on the PTO and adjusts the engine throttle to maintain speed of the work tool with every change in load. It works in conjunction with the engine speed governor, as calibrated by the manufacturer. Where there's no governor in the carburetor, a sandwich-type governor is installed between carburetor and manifold. Eliminates "watchdogging" on the engine.



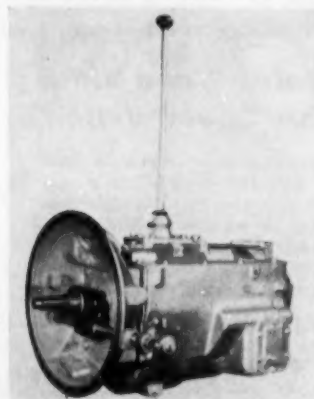
Designed for hydraulic pumps but can be adapted to any hydraulic or mechanical devices powered by gasoline engines. Must be custom fitted to vehicle and equipment. *Holley Carburetor Co., Warren, Mich.*

Circle 211 on Reader Service Card

Heavy duty transmission

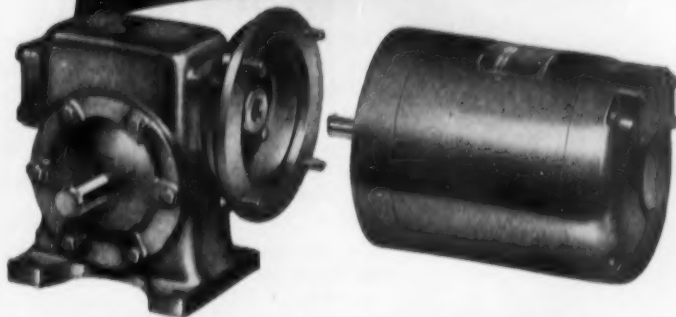
New Torqmatic for trucks, scrapers, graders, etc., in 200-300 hp range.

Model CLBT-4460 can handle 700 ft lb of engine torque at speeds to 2500 rpm. Six speeds forward,

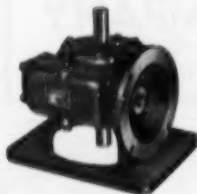


one reverse, with hydraulic retarder, lock-up clutch, converter and 4 PTO's as standard features. Three element torque converter ranges

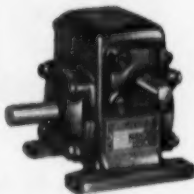
*Precision Engineered-
Performance Tested*



PERFECTION Worm Gear SPEED REDUCERS



One of our major capabilities is to design, develop and produce speed reducers that will insure maximum performance and economy in your operation. Our experience in the special problems and objectives of power transmission is broad and deep. The men at American Stock Gear having this important capability, use the most advanced analytical engineering facilities to design speed reducers to meet tomorrow's needs.



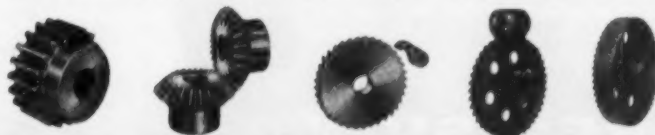
Whatever size or style reducer you need, you'll find the right combination in the complete Perfection line — a line that is precision engineered and performance tested in thousands of different applications.



If you have a reducer problem that you feel is "different", our engineers are ready to advise, design and produce speed reducers to your particular requirements. In the meantime, write for your copy of our Reducer catalog containing illustrations, charts and tables to help you on your next application.



We make a complete line of stock gears. Send for Gear catalog No. 360.

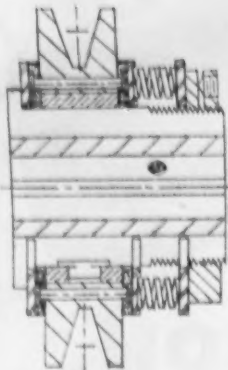


AMERICAN STOCK GEAR DIVISION
PERFECTION GEAR COMPANY, HARVEY, ILLINOIS

Circle 4 on Reader Service Card

What some folks won't do to use a **CONWAY CLUTCH!**

YUP! IT FIGURES!



**TORQUE LIMITERS,
ANYONE?**

Q. Did you know that there is no known way to calculate the force exerted by a Belleville spring?

A. Yup!

Q. Did you know that there is a way to calculate the force exerted by a coil spring?

A. Yup!

Q. Did you know that if we don't know the force we can never calculate the torque?

A. Yup!

Q. Do you use CONWAY—the coil spring coil limiter?

A. Yup!

IT FIGURES!

Drop us a line . . get details . . get bulletins.

The CONWAY CLUTCH COMPANY

The World's Most Respected Name in Clutches for over a Half-Century

2754 COLERAIN AVE.

CINCINNATI, 25, OHIO

PRODUCT NEWS

up to 3.6:1. Optional gear ratio steps of 1.41:1 or 1.31:1, giving an overall coverage of 5.66:1 or 3.96:1. *Allison Div., General Motors Corp., Indianapolis, Ind.*

Circle 212 on Reader Service Card

Ball bearing screws

Steel and nylon washers replace stop pins, to limit nut travel.



With this new design, a set of three washers, two steel and one nylon, replace each stop-pin. The washers are stronger, eliminate breakage. *Saginaw Steering Gear Div., General Motors Corp., Saginaw, Mich.*

Circle 213 on Reader Service Card

Speed reducer/increaser

Uses toothed belts in the gearing. Needs no oil

Dry Gear Dryvex mount in any position, have a compact axial pro-

PROVEN BEST IN THOUSANDS OF APPLICATIONS



**PRECISION
UNIVERSAL
JOINTS**

PTD-41

Made from high quality aircraft steel, machined to extremely close tolerances. Interchangeable parts specially heat treated to a uniform hardness throughout. Available blank, bored, broached, threaded, cross drilled or tapped to your exact specifications.

PRECISION

PRECISION TOOL & MFG. CO. OF ILLINOIS
1305 S. LARAMIE AVENUE / CICERO-30, ILLINOIS

clip
this
ad to
your
letter-
head!

Circle 30 on Reader Service Card

PTD-101



NEW! MANHEIM VARIABLE SPEED BELT

Now Outdates Wood Block and Variable Speed V-Belts

MVS Belt replaces enclosed drive belts without disassembly. Its patented design sets a new standard in V-to-V drives because it is adjustable and is installed in minutes instead of hours. Uniform thickness and width guarantee constant power delivery with no cross-sectional distortion. Available in 26 widths from 1 1/4" thru 5".

Write Today For Complete Information



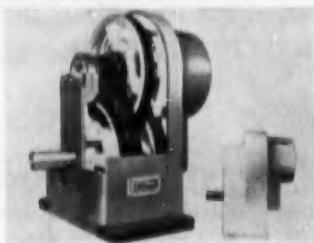
**MANHEIM
MANUFACTURING &
BELTING COMPANY**
Manheim 9, Penna.

© M. M. & B. Co. 1958

Circle 28 on Reader Service Card

POWER TRANSMISSION DESIGN

file and are quiet running. Factory-packed anti-friction bearings allow a temperature range of -60 to 200 F. Standard $\frac{1}{2}$, $\frac{3}{4}$, 1, 1 $\frac{1}{2}$ and 2-hp, rated on output. Shaft speeds



from 16 $\frac{1}{2}$ -rpm to 780-rpm. Custom built units provide speeds from 1-15,000-rpm. *Machine Control, Inc., Minneapolis, Minn.*

Circle 214 on Reader Service Card

Splice lap grinder

Make your own belt lengths in plant maintenance shop.

The machine cuts a 30-deg. angle splice in 6 and 20-in. widths. This angle increases splice strength, as the whole closure does not hit the pulley at the same time. On polymer-cored leather belts the splice has two different tapers for the leather and plastic. Can also splice 20 1-in. belts simultaneously. *Extremulus Inc., Englewood, N. J.*

Circle 215 on Reader Service Card

Pedestal bearing

Replaces cast iron mountings, for reduced costs.



This is another version of the standard AE series originally designed for circuit breakers. Large lubricant reservoir in the bearing ball unit. Model shown is AEH1367- $\frac{1}{2}$ in. Assembly comes with mounting bolts. Can also be used for motor starters, etc. *Triangle Mfg. Co., Oshkosh, Wis.*

Circle 216 on Reader Service Card



Big Gears...

fast delivery on custom requirements

SPUR • HERRINGBONE • HELICAL

Horsburgh & Scott specializes in fast production of quality industrial gearing . . .

Gears engineered to meet custom requirements in a wide range, from small to large sizes.

Speed Reducers produced in standard types and special drives for fast custom delivery.

Send your specifications, or let our technical staff make recommendations.

Write for Catalog FLB-60



The HORSBURGH & SCOTT CO.

5112 Hamilton Avenue • Cleveland 14, Ohio

Manufacturers of Gears and Speed Reducers for over 75 years

Circle 22 on Reader Service Card

Elliott FLEXIBLE SHAFTS

- CUT COSTS
- SAVE TIME
- ELIMINATE MOVING PARTS



Elliott Flexible Shafting drives machine used for slosh-vibration tests of aircraft fuel cells with gross weight of 7 tons. Machine rocks through 30-degree arc on concave track. Flexible shafting drives vibrating table 2800 cycles per minute in full $\frac{1}{2}$ " circle.



Textiles are sized, stretched and dried on above machine. Fabric is transferred to picks on moving overhead tracks and carried out 100' for sizing and drying. Two Elliott Flexible Shafts perfectly synchronize lateral motion and varying speed in pick drive.



Elliott is America's largest manufacturer of flexible shafting for concrete vibrators. Dryer mixes, stronger, more uniform concrete are the results.



Write for our
Catalog 263

FLEXIBLE SHAFT DATA
FOR DESIGNERS

B.W. ELLIOTT MFG. CO., INC.
251 State St., Binghamton, N. Y.

Circle 16 on Reader Service Card

LITERATURE

ON DRIVES AND COMPONENTS

Automatic clutch

Power-Max adjustable centrifugal clutches are featured in 4-page engineering and data folder. The device combines automatic clutch, starting and acceleration control, and torque selector. Folder gives application classes and ratings, plus specifications and dimensions for direct drive, V-belt and flat belt types. *Olme Precision Inc., Portsmouth, Ohio.*

Circle 300 on Reader Service Card

Sprockets with shear pin hubs

These hubs prevent damage from jamming. A necked pin which shears at a predetermined load, allowing the outer part of the hub and the sprocket to rotate. Can also be used with sheaves, gears, clutches etc. Specifications and data in Catalog GD-104-A. *Browning Mfg. Co., Maysville, Ky.*

Circle 301 on Reader Service Card

Dry fluid drives

Bulletin No. 70 lists 8 stock drives and 11 stock couplings in the Flexidyne line. Covers fractional to 1000 hp, with installation photos and engineering drawings. Tables of weights, dimensions, prices and recommended V-belt drives according to size. Includes details of the Duplex Flexidyne and special coupling arrangements. *Dodge Mfg. Corp., Mishawaka, Ind.*

Circle 302 on Reader Service Card

Variable speed belts

Bulletin 24103 has 14 pages of replacement listings. Tables give equivalent Wood's belt for equipment, and other belts. A numerical listing table classifies belts according to size using the new standardized numbering system, with width of sheave groove in sixteenths, groove angle in degrees, and belt pitch length in inches and

tenths. A cross reference table compares standardized belt numbers with differently classified belts. Final table shows old and new Wood's numbers. *T. B. Wood's Sons Co., Chambersburg, Pa.*

Circle 303 on Reader Service Card

Hydrostatic transmission

Bulletin DP-2 highlights applications of Dynapower hydrostatic transmissions to off-the-road traction drives, mixing drum drives, winch and fan drives, and remote drives. Gives specifications, performance curves and dimensions. *Watertown Div., New York Air Brake Co., N. Y.*

Circle 304 on Reader Service Card

Tolerance ring catalog

Gives full dimensions of 450 stock sizes and shows a number of typical applications. A cut-out ordering form tabulates data needed for correct selection. Catalog SFTR 10, 18 pages. *Roller Bearing Co. of America, West Trenton, N. J.*

Circle 305 on Reader Service Card

Spring washer catalog

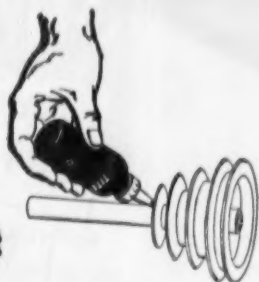
Belleville, Sawtooth Belleville, arc, 3-wave, and other types of spring washers are illustrated and listed for easy selection by type or size. Describes spring washer characteristics and explains Garrett's embrittlement-free zinc plating process. *George K. Garrett Co., Inc., Philadelphia, Pa.*

Circle 306 on Reader Service Card

Shaft mounted reducer

Bulletin GEC-1468, 15 pages, covers single and double reducers in a wide range of ratings. Shows you how to order, with tabulated selection and pricing info and has 7 pages of sheave and V-belt com-

**Simplify
and
speed
any shaft
assembly with
LOCTITE®**



LOCTITE Sealant, "the liquid lock for metal parts," eliminates press fits, shaft distortion, keyways, set screws, etc., when assembling fans, pulleys, couplings, impellers, gears, rotors, armatures, etc. LOCTITE ends repairs and loosening caused by vibration. Simplify your production methods with LOCTITE Sealant.

Call your distributor, or write
for literature and free samples.

LOCTITE® SEALANT

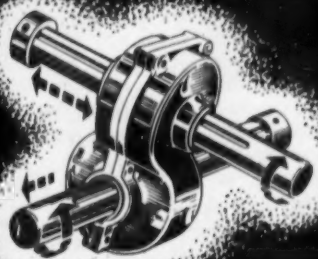
AMERICAN SEALANTS COMPANY

457 North Mountain Road, Hartford 11, Connecticut

**THE MOST FLEXIBLE RIGHT
ANGLE GEAR DRIVE DESIGNED**

**FLOAT
-a-
SHAFT**

**UNIVERSAL
RIGHT ANGLE
GEAR DRIVE
COUPLING**



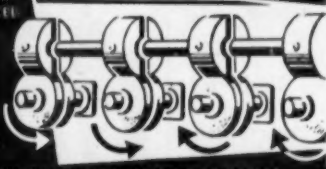
New, versatile gear drive designed to meet the needs of many applications requiring power transmission at right angles with a 1:1 ratio.

Easy to install, the floating feature of the unit permits self-alignment on the driving and driven shafts.

Ideal for operating packaging equipment, farm machinery, conveyors, rollers and all types of industrial equipment.

FEATURES

- FLOATS ON SHAFT FOR EXCEL-
LENT ADAPTABILITY TO
DIFFERENT MACHINES
- EASY TO INSTALL
NO COUPLINGS NEEDED
- SELF-ALIGNING
- HIGH HORSEPOWER AND
TORQUE CAPACITY
- HARDENED HELICAL GEARS
FOR RUGGED OPERATION
- ALUMINUM HOUSINGS LIGHT WEIGHT COMPACT FOR TIGHT FITS



Tol-O-Matic, Inc.

246 Tenth Avenue South • Minneapolis 15, Minn

Circle 40 on Reader Service Card

October, 1961

How To Assure THE MAXIMUM In High Response Clutch-Brake Systems

*The clutch-brake unit you use
must provide these basics:*

- ① minimum armature transfer distance between the brake and clutch housings.
- ② clutch and brake friction surfaces held to a high degree of parallelism.
- ③ no backlash between armature and shaft.
- ④ clutch and brake friction facings burnished to give rated torque on installation.
- ⑤ closely held tolerances and finishes on all important surfaces.
- ⑥ minimum armature inertia without any sacrifice in mechanical strength.
- ⑦ magnetic circuit ability to respond to the field-forcing technique mentioned below.
- ⑧ positive armature release through absence of metal to metal contact and built in return action.

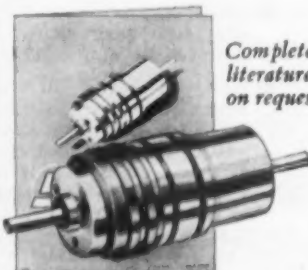
Because of the exclusive patented diaphragm, these features have been built into Simplatrol electric clutches and brakes.

The electric circuitry employed determines to a large extent the clutch reaction time. Reaction time is ordinarily reduced when a high momentary over-voltage is supplied (i.e., a voltage considerably in excess of the steady state rated voltage). Simplatrol can provide helpful suggestions on circuitry. Time required to bring load up to speed is a function of load inertia, r.p.m., and the torque of the clutch-brake.

Simplatrol's engineering organization will work with you to accomplish maximum speed, smoothness and quietness in your clutching and braking. Ask about applications of standard and custom designs in Simplatrol Electric Clutches and Brakes.

*Investigate the total
efficiency and economy of
operation of the single
complete unit, in torque
ratings of 10 ounce inches
to 470 pound feet, in sizes
from 7/8" dia. to 12 1/2" dia.*

See for yourself the unique advantage of the flexible diaphragm action . . . the only moving part in a Simplatrol unit. Get the facts now on Simplatrol clutches and brakes.



*Complete
literature
on request*

Simplatrol products corp.
24 SALISBURY ST., WORCESTER, MASS.—

971-0

Representation in Key Industrial Areas

Circle 37 on Reader Service Card

Lovejoy

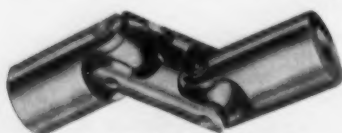
Precision-Made Industrial UNIVERSAL JOINTS

For Applications Up to 1750 RPM.

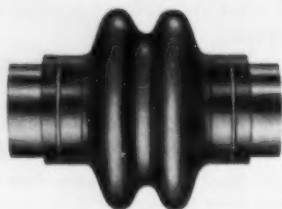
Here is a line of high quality universal joints for all industrial applications. Joints are available in an extremely wide range of sizes in each of the following general types:



Standard and Heavy Duty Single Joints—Type D



Standard Double Joints—Type DD



Booted Joints

Also Special Joints Engineered to Order

- .35 to 190 HP. at 100 RPM.
- Standard joints operate at speeds up to 1500 rpm. and heavy duty to 1750 rpm.
- Single joints operate through a full working angle of 40° and double joints 80°
- Made of case-hardened fine alloy steels for light weight and exceptional durability
- Boot provides an effective means of proper lubrication for heavy load, high speed and high heat applications... eliminates dust... can be removed and repacked in field

For detailed information on complete line ask for Bulletin D-61 on company letterhead. Also request recommendations for your application.

Lovejoy

FIRST
NAME IN
UNIVERSAL
JOINTS

LOVEJOY FLEXIBLE COUPLING CO.

4852 W. Lake Street • Chicago 44, Illinois

LITERATURE

binations. Provides a cutaway of construction and a final table of application by classification. *General Electric Co., Gear Motor & Trans. Components Dept., Paterson, N. J.*

Circle 307 on Reader Service Card

Vibration/shock/noise control

Facilities brochure describes the origin, products, and services of company specializing in vibration control. Gives bonded rubber/steel story, illustrates research and production techniques and discusses lines of future development. *Lord Mfg. Co., Erie, Pa.*

Circle 308 on Reader Service Card

Belt drive catalog

Twenty-four page catalog SW-1 tells you how to reduce drive size by 50% and make drive cost reductions up to 20% with no loss in hp, by using the Super-Wedge Drive. Includes selection tables, ratings, sheave dimension tables and installation instructions. *Maurey Mfg. Corp., Chicago, Ill.*

Circle 309 on Reader Service Card

General-purpose ac motors

Bulletin L-3313A, 6 pages, covers a line of ac 56 frame motors from ¼ to 2 hp single-phase capacitor-start or three-phase squirrel-cage. Gives selection and specification data, dimensions, mounting arrangements and performance curves. Also illustrates special designs. *Howell Electric Motors Co., Detroit, Mich.*

Circle 310 on Reader Service Card

One-piece gear and pinions

Revised 10-page catalog (No. 3001-C) includes the newest combinations of die cast zinc alloy one piece gear and pinions, off-the-shelf or from stock dies. Describes low-cost selection service. Detailed engineering drawings show pitch, number of teeth, pitch diameter etc. More than 200 combinations. *Gries Reproducer Corp., New Rochelle, N. Y.*

Circle 311 on Reader Service Card

SIMONDS

INDUSTRIAL CUT GEARS

LARGE OR SMALL
HEAT TREATED OR
PLAIN



SIMONDS has over 60 years' experience in cutting quality industrial gears. We can supply any type of gear in

cast or forged steel, gray iron, bronze, Meehanite, rawhide or bakelite in a full range of sizes adaptable to the material. Also heat-treated, case or flame hardened gears of carbon or alloy steel. Send us your requirements for quotation.

Custom GEAR CUTTING

SIMONDS' facilities can produce any type of custom gear from your blanks if you prefer. Same quality... same prompt service.



QUALITY
GEARS
FOR OVER
65 YEARS

SPUR GEARS
BEVEL GEARS
MITRE GEARS
WORMS WORM GEARS
RACKS PINIONS

Also stock carrying distributors of Ramsey Silent Chain Drives and Couplings; and industrial V-belts.



THE SIMONDS GEAR & MFG. CO.

LIBERTY at 25TH

PITTSBURGH 22, PA.

Circle 36 on Reader Service Card
POWER TRANSMISSION DESIGN

Expanded rod-end catalog

New standard items included are large rod ends with bores up to 2-in., and control rod assemblies in six sizes. Stud-end rods also listed. Catalog 102. *Split Ballbearing, Div. of MPB, Inc., Stratford, Conn.*

Circle 312 on Reader Service Card

Motor rides piggyback

How direct mounted motor on the Low Head screen saves headroom and reduces belt cost and wear is described in Bulletin 26B9990. Diagrams show how direct mounting does away with overhead structures and belt tensioning and alignment problems. *Allis-Chalmers Mfg. Co., Milwaukee, Wis.*

Circle 313 on Reader Service Card

Data sheet on sealed bearings

Complete engineering information on the new Flexal bearing comes in 4-page Data Sheet F-1. Covers performance, dimensions, size, and design characteristics. *The Barden Corp., Danbury, Conn.*

Circle 314 on Reader Service Card

Motor bulletin

Twenty pages on 385 types and models of synchronous motors. Includes speed-torque curves, drawings, wiring diagrams and photographs of each type. Also compares performance characteristics. *Bodine Electric Co., Chicago, Ill.*

Circle 315 on Reader Service Card

Dry lube stops galling

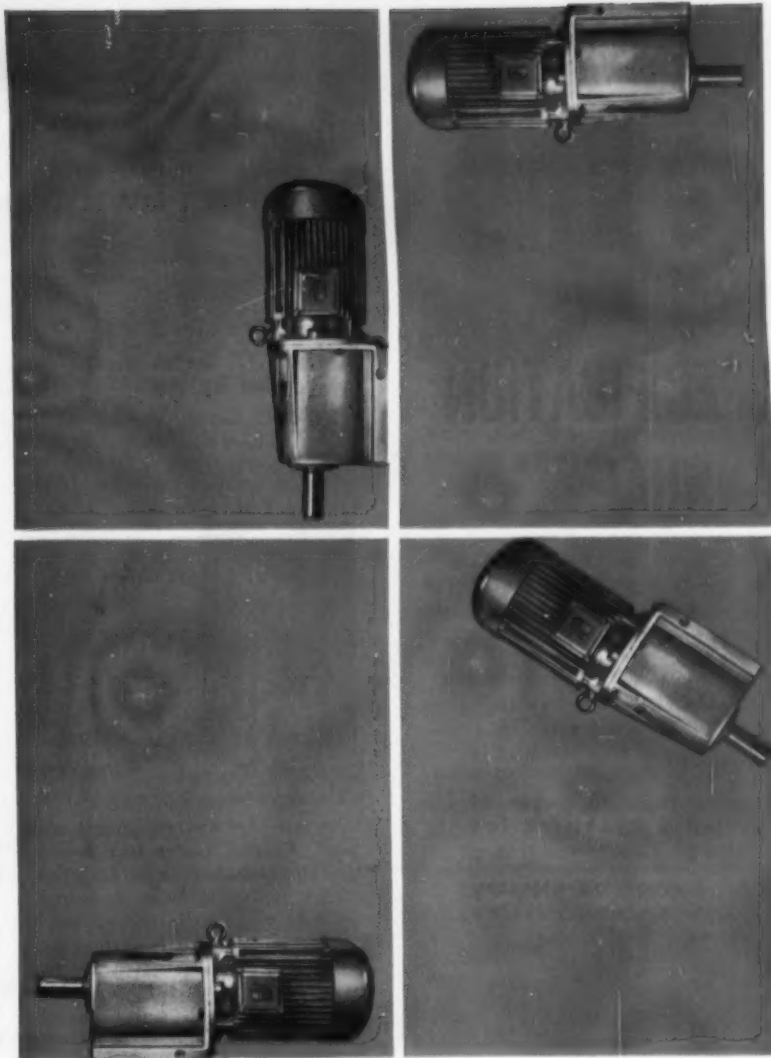
Bulletin 131 illustrates typical applications of Molykote G, a grease-type lubricant with molybdenum disulphide. *Alpha-Molykote Corp., Stamford, Conn.*

Circle 316 on Reader Service Card

Endless polyester belts

Bulletin 2 lists features and specifications of Mylar and Cronar endless belts in widths from 1/4 in. or less, to 60 in. Belts are precision spliced by an ultrasonic method requiring no heat or special end preparation. *International Ultrasonics, Inc., Cranford, N. J.*

Circle 317 on Reader Service Card



UP OR DOWN **BAUER** RUNS

Position a low-priced Bauer Gear Motor vertically or horizontally. Mount it up on a wall or down on the floor—even head down on the ceiling—it will deliver consistent, effective power for in-plant production use. Heavy duty helical gears of high-grade, case-hardened steel assure silent operation. And the compact, single-unit construction cuts down on maintenance time... reduces safety hazards. Bauer Gear motors deliver about 8,000 operating hours before gear box grease requires changing.

Range: from 1/50 to 30 HP. **Ratings:** 0.3 to 800 RPM.

All motors TEFC, Class II gears at no extra cost.

Over 30 Years of Gear Power from

BAUER

Distributed and serviced in 50 states.

For information, catalog and nearest distributor, write

GEORG VON OPEL CORP. 15 WILLIAM ST., NEW YORK 5, N. Y.

Circle 15 on Reader Service Card

COMING IN JANUARY

**POWER
TRANSMISSION
DESIGN**

PRODUCT SPECIFICATION ANNUAL

A "keep copy" issue of reference material valuable to designers and users of power transmission equipment.

Includes:

- more than 30 pages of detailed specification charts
- An engineering glossary of power transmission terms

Charts will show use, materials, sizes available and power and speed ratings for the following products:

Bearings
Gear Drives
Chain Drives
Mechanical Seals
Belt Drives
Electric Motors
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**Look For It
JANUARY, 1962**

MEN

OF THE POWER TRANSMISSION FIELD

**Charles C. Gates dies;
succeeded by son**

Charles C. Gates, president of the Gates Rubber Co., died on August 29 in Denver, Colo.



Gates, Sr.



Gates, Jr.

A one-time western mining engineer, Charles Gates was founder and first president of the Company, which he made from a one-man shop known as the Colorado Tire and Leather Co., into the sixth largest rubber manufacturing concern in the U. S. It is one of the few major U. S. companies still owned and managed by the founding family.

Charles C. Gates, Jr., chosen by the Board to succeed his father, was educated at MIT and Stanford, where he received his bachelor degree in engineering. He worked in the Company engineering department from 1946 until 1949, when he was named a vice president. He became executive vice president of the company in 1958.

In accepting the presidency, Gates Jr. said there will be no change in the company policy.

Falk appointments

Thomas F. Scannell is the new vice president-director of international operations for the Falk Corp. Formerly vice president-general sales manager, he takes over his new job immediately reporting directly to Harold Falk. Don K. Lambert, who was manag-

er of export sales, will be director of international sales.

Scannell's post as general sales manager will be taken over by Sands G. Falk, appointed sales manager of the eastern division, and Kenneth O. Hood, appointed sales manager of the western division.

**Howard fills new post
at Fairbanks, Morse**

Sheldon K. Howard has a new assignment as director of marketing for the Beloit (Wis.) Group of Fairbanks, Morse & Co.

Howard, manager of the company's diesel engine sales, also will guide the marketing of other products made at Beloit—magnetos and engine accessories, compressors, large pumps and large electric motors.

A 22-year veteran with Fairbanks, Morse, Howard managed its diesel sales in Atlanta from 1951 to 1959. He holds a mechanical engineering degree from the University of Maine.

**Commercial director for
U. S. Rubber**



Meade

Edwin D. Meade, new director of commercial relations for United States Rubber Co., will place his main emphasis on new market opportunities. He will also help to develop national accounts which

use products of two or more of the company's divisions.

Meade joined the company in 1935 as a mechanical goods salesman and has held posts in field sales, commodity sales and headquarters sales management. He

helped to start the company's Washington office, now the government department, and has had extensive sales experience with government agencies and other national accounts. Meade was formerly manager of national accounts and trade relations, mechanical goods division.

Dana Corp. promotes two

Latest promotions from the Dana Corp. are W. H. Schomberg, Jr., from assistant to general sales



Schomberg



Henson

manager; and John P. Henson, former manager of the Universal Joint Div., now assistant general sales manager.

Schomberg joined Dana in 1945

with an M. E. degree from University of Michigan, has been a sales engineer for passenger cars and product sales manager for clutches and universal joints.

Henson came to Dana in 1959 from the Bendix-Westinghouse Co., where he was Cleveland regional manager. In 1960 he became sales manager of the Universal Joint Div. He holds a B.S.M.E. from Purdue.

Globe appoints sales manager

Russell S. Egbert will handle sales for Globe's Stock Gear Division's midwest region, covering six states.

Prior to coming to the Stock Gear Div., Egbert was general manager of Globe Gear Co.'s affiliate, Globe Transmission Corp.

Will represent Acme Chain in South

John W. Carter, with thirty years of experience in designing, making and selling industrial machinery, has been made a representative for

the Acme Chain Co. Working from Atlanta, he will cover Georgia, Alabama, Eastern Tennessee and Florida.



Carter



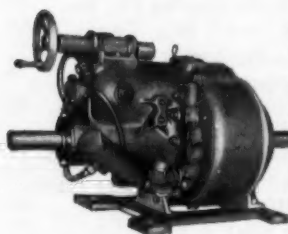
Heath

American Sealants names west coast sales manager

George F. Heath has been appointed district sales manager by the American Sealants Co. Based in Los Angeles, he will work with the company's representatives and distributors to co-ordinate sales throughout the eleven-state western area.

Before joining American Sealants, Heath represented the Hays Corp., and also the Foxboro Co. He is a mechanical engineering graduate from Tri-State College, Ind.

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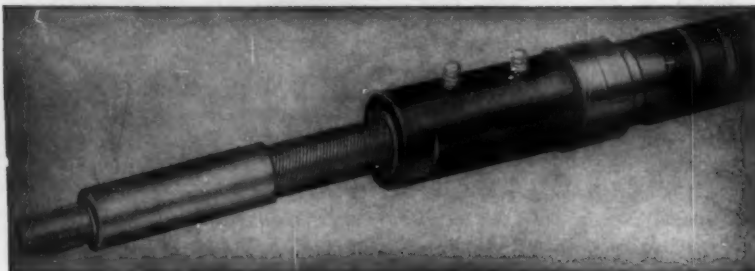
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HOW TO SELECT FLEXIBLE SHAFTING FOR POWER DRIVE APPLICATIONS



1/4-inch STOW Power Drive flexible shaft with core assembly pulled out of casing.

For Power Drive applications, the following factors must be considered:

1. Torque (Lb. In.) to be transmitted (The starting torque should be used in making selections.)

2. Operating Speeds (RPM) — If the maximum speed is higher than the rated speed, torque ratings in the table below do not apply. To find the torque capacity for flexible shafts operating at speeds higher than the rated speeds, multiply the maximum dynamic torque capacity by the rated speed, and then divide by the operating speed. (See example.)

3. Operating Radius — In making the selection from the table below, the radius of the smallest bend in the flexible shaft should be used.

Ratings — The ratings for flexible shafts shown in the table below apply under the following conditions:

1. When the flexible shaft is adequately supported by clamps along its length. (For unsupported shafts, multiply the calculated torque by a safety factor of 1.6—see example below.)

2. When the flexible shaft is operated in the wind-up direction, which tends to tighten the outer layer of wires. (Flexible shafts operated in the unwind direction will transmit only about 60% of the rated torque.)

3. When the flexible shaft is in continuous operation. Note: the ratings are based on temperature rise. When the operation is intermittent, the ratings in the table may be exceeded. Consult Stow engineers for specific recommendations.

RATED SPEED R.P.M.	MAXIMUM DYNAMIC TORQUE CAPACITY (LB. IN.)										Wgt./ C. Ft.	Core Dia.	Core No. and Type	Shaft Size
	STRAIGHT AND CURVED SHAFTS													
	RADIUS OF CURVATURE IN INCHES													
	30 to Strgt.	25	20	15	12	10	8	6	5					
4,500	2.4	2.2	2.0	2.0	1.92	1.9	1.7	1.5	1.25	3.0	.124/.128	2049 MH	13	
3,800	7.0	6.4	6.0	5.8	5.4	5.0	4.6	3.6	2.0	4.5	.148/.152	2081 MH	15	
2,900	9.4	8.6	8.0	7.6	7.0	6.6	6.0	4.8	3.4	7.0	.185/.189	5108 MH	19	
2,500	22.0	20.0	18.8	17.6	16.0	15.0	12.6	10.8	9.0	12.5	.247/.252	8924 MH	25	
1,800	30.0	28.0	26.4	25.0	23.0	21.0	18.0	14.0		20.0	.308/.313	8925 MH	31	
1,800	33.8	31.5	29.7	28.1	25.9	23.6	20.2	15.8		20.0	.308/.313	8969 T	31	
1,800	36.0	33.0	31.6	30.0	28.0	26.0	22.0	18.0	11.0	21.0	.324/.329	2034 A	31	
1,500	80.0	66.0	63.0	58.0	51.0	46.0	37.0	22.0		28.5	.368/.374	2035 A	38	
1,500	60.0	54.0	50.0	46.0	42.0	38.0	30.0	24.0		29.0	.387/.393	8970 MH	40	
1,500	90.0	81.0	75.0	69.0	63.0	57.0	45.0	36.0		29.0	.387/.393	8971 T	40	
1,150	136.0	110.0	104.0	94.0	80.0	72.0	56.0			50.5	.497/.503	8999 A	50	
1,150	148	124	110	92	72	56				53.5	.505/.511	6940 T	50	
900	248	200	176	124	84					78.5	.610/.618	6997 T	63	
900	220	204	192	180	152	130				80.5	.630/.638	7731 A	63	
750	340	324	316	76						117	.747/.753	2056 T	75	
600	760	520	420							205	.998/1.004	2057 T	100	
440	1,500	720								343	1.298/1.304	2058 T	125	

EXAMPLE: How to use the table:
The problem is to transmit 1/2 HP at 1700 RPM through an unsupported flexible shaft in a 25" radius, estimated starting torque 150% of normal operating torque.

$$1. \text{ Calc. Torque (lb. in.)} = \frac{\text{HP} \times 63000}{\text{RPM}} = \frac{.5 \times 63000}{1700} = 18.5$$

$$2. \text{ Correction factor for starting torque} = 1.5 \times 18.5 = 27.75$$

3. Correction factor for unsupported shaft $27.75 \times 1.6 = 44.4$ lb. in.

4. Refer to Table above. Read downward in column under 25" radius until you find a core having a rating of at least 44.4 lb. in. In this case we find that core No. 8970 is rated 54 lb. in. at 1500 RPM. Since the given speed is 1700 RPM, multiply 54 by 1500 and divide by 1700. $54 \times 1500 \div 1700 = 47.6$ lb. in. (rated torque at 1700 RPM). Therefore, Core No. 8970 is correct.

For Engineering Bulletin No. 570 and a free torque calculator, write



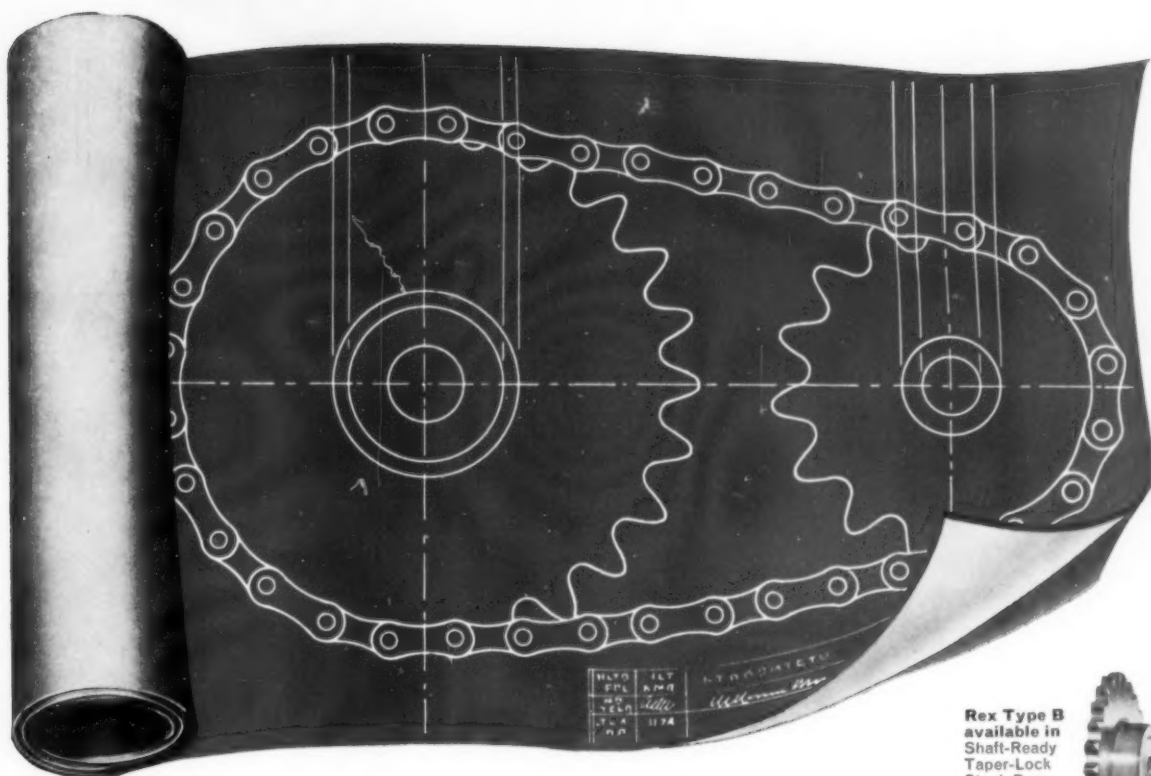
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INDEX OF ADVERTISERS

American Bilt-Rite Rubber Co.	
Boston Woven Hose and Rubber Div.	15
American Pulley Co.	38
American Sealants Co., Inc.	61
American Smelting & Refining Co.	54, 55
American Stock Gear Div.	
Perfection Gear Co.	57
Atlas Chain & Mfg. Co.	16
Browning Mfg. Co.	13
Chain Belt Co.	Cover III
Cincinnati Gear Co.	51
Cone Drive Gears	
Div. of Michigan Tool Co.	20
Conway Clutch Co.	58
Crown Gear Co.	52
Cullman Wheel Co.	17
Dalton Gear Co.	11
Dodge Mfg. Corp.	32 & 33
Elliott Mfg. Co.	60
Federal Bearings Co., Inc.	42
Formsprag Co.	52
Garlock, Inc.	47
Gates Rubber Co.	4
Gray & Prior Machine Co.	54
Hilliard Corp.	8
Horsburgh & Scott Co.	59
Industrial Clutch Corp.	56
Locke Steel Chain Co.	65
Lovejoy Flexible Coupling Co.	62
Manheim Mfg. & Belting Co.	58
Maurey Mfg. Corp.	1
Minster Machine Co.	12
National Pneumatics Co., Inc.	
Janette Motor Div.	53
Orange Roller Bearing Co., Inc.	49
Precision Tool & Mfg. Co.	58
Raybestos-Manhattan	
Manhattan Rubber Div.	7
Roberts Electric Co.	65
Rockford Clutch Div.	
Borg-Warner Corp.	18
Rockwell-Standard Corp.	37
Schatz Mfg. Co.	48
Sier-Bath Gear & Pump Co.	31
Simonds Gear & Mfg. Co.	62
Simplatrol Products Corp.	61
Stearns Electric Corp.	6
Stow Mfg. Co.	66
Tol-O-Matic, Inc.	61
Tormag Div.	
Gleason-Reel Corp.	56
Triangle Mfg. Co.	56
United Motors Service Div.	
General Motors Corp.	41
U. S. Electrical Motors	Cover II
U. S. Rubber Co.	2 & 3
Von Opel Corp.	
Eberhard-Bauer	63
Warner Electric Brake & Clutch Co.	35
Winsmith Inc.	9
T. B. Wood's Sons Co.	19



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